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**D.CLIN. PSYCHOL.
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TRAINING PROGRAMME**



Is there a relationship between loneliness and psychotic experiences? An empirical investigation and a meta-analysis.

**Beata Michalska da Rocha
Doctorate in Clinical Psychology
The University of Edinburgh
May 2016**

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Date 29 April 2016

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This work is dedicated to my family: my husband – Mauricio, mum - Danusia, dad - Wiesiek, sister - Edyta and my grandmother - Ala.

Thesis Abstract

Purpose

The aim of the systematic review and meta-analysis was to determine the magnitude and strength of the loneliness-psychosis relationship, and to synthesise current evidence. The aim of the empirical investigation was to establish whether, in older people, loneliness may increase proneness to auditory hallucinations and perceiving visual human-like features in ambiguous stimuli.

Methods

For the meta-analysis a search of electronic databases was conducted (PsychINFO, MEDLINE, EMBASE and Web of Science). Studies were included if they reported usable data relating to the association between loneliness and psychotic symptoms. A random effects meta-analysis was used to compute a pooled estimate of the correlation, together with 95% Confidence Intervals (CI). Study quality and outcome quality were systematically assessed using adapted versions of the Agency for Healthcare Research and Quality (AHRQ) tool and GRADE approach, respectively. For the empirical study, a parallel group experimental design with random allocation to experimental conditions was employed. Participants (62 healthy adults aged 65 and above) were assigned to one of the two conditions – the experimental condition or a control condition. A loneliness induction procedure was employed in the experimental condition whereas participants in the control condition completed a neutral task. A logistic regression was conducted to evaluate performance on auditory and visual tasks across the groups and an odds ratio was calculated.

Results

Thirteen studies were included in the meta-analysis, providing data from 15,647 participants. A moderate association between psychosis and loneliness was observed ($k=13$, $N=15,647$, $r=0.32$, 95% CI 0.20, 0.44; I^2 97.56%; moderate quality evidence). Whether loneliness was assessed by single-item or a more comprehensive measure had no moderating effect on the estimate.

The experimental study revealed that participants in the neutral condition were significantly less likely to hear words in ambiguous stimuli than those in the experimental condition (OR = 0.70, 95% CI 0.51 – 0.94, $p < 0.05$). Exploratory analysis revealed that higher scores on the

state loneliness measure were associated with an increase in the likelihood of hearing words (OR=1.17, 95% CI 1.01-1.35, $p = 0.03$). No effect of loneliness induction was found on perceiving human-like features in ambiguous visual stimuli.

Conclusions

The meta-analysis confirmed a significant positive relationship between loneliness and psychosis, while the experimental study suggested that loneliness may have a causal role in the development of subclinical auditory experiences in older people. Further studies examining whether loneliness is involved in proneness to other psychotic experiences would be beneficial.

Chapter 1. Systematic review and meta-analysis – a journal article

Loneliness in psychosis: a meta-analytical review.

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Written in accordance with the instructions for authors for the Clinical Psychology Review
(see appendix A.1 for author guidelines)

Abstract

Aims Loneliness may be related to psychotic symptoms but a comprehensive synthesis of the literature in this area is lacking. The aim of the current study is to determine the magnitude and reliability of the loneliness-psychosis relationship in people diagnosed with schizophrenia or related disorders, taking into account study quality, and whether it is moderated by method of assessment.

Method A search of electronic databases was conducted (PsychINFO, MEDLINE, EMBASE and Web of Science). A random effects meta-analysis was used to compute a pooled estimate of the correlation between loneliness and psychotic symptoms. Study and outcome quality were assessed using adapted versions of the Agency for Healthcare Research and Quality (AHRQ) tool and GRADE approach, respectively.

Results Thirteen studies were included, providing data from 15,647 participants. A moderate association between psychosis and loneliness was observed ($k=13$, $N=15,647$, $r=0.32$, 95% CI 0.20, 0.44; I^2 97.56%; moderate quality evidence). Whether loneliness was assessed by a single-item or a more comprehensive measure had no moderating effect on the estimate.

Conclusion There is a significant positive relationship between loneliness and psychosis. Further studies are needed to determine the causal status of this relationship, but this robust finding should be considered in clinical practice and treatment provision for those with psychotic disorders.

Highlights:

- There is a moderate association between loneliness and psychosis
- Results obtained by a single-item loneliness measure were in line with those obtained by validated instruments
- Further studies are needed to determine the causal status of this relationship

Keywords: loneliness, psychosis, psychotic disorders, loneliness measures, review.

INTRODUCTION

People with psychotic disorders frequently feel lonely and many expect to be lonely in the future (Morgan et al., 2012). Stain et al. (2012) report that as many as 80% of adults with a diagnosis of psychosis in Australia reported feeling lonely in the past 12 months. People with psychosis often struggle to develop and maintain functioning relationships, have limited social networks and restricted access to social support outside of what is provided by mental health services (Beels, 1981; Norman et al., 2005).

Although feelings of loneliness and social isolation are generally thought to reflect the negative impact of psychotic experiences (e.g. Møller & Husby, 2000), more recently it has been reported that loneliness may also play a causal role in the development of psychotic experiences (van der Werf, van Winkel, van Boxtel, & van Os, 2010). A self-perpetuating cycle of exclusion may develop, whereby the disorder limits connections and support, which then leads to a removal of important buffers, thereby increasing risk of relapse and causing an escalation of psychotic episodes, further social disengagement, and so forth (Gayer-Anderson & Morgan, 2013).

The majority of studies examining social support in psychosis have concentrated on quantitative features of the social network such as size and reciprocity instead of more functional aspects such as loneliness or satisfaction with relationships (Gayer-Anderson & Morgan, 2013). This is of particular relevance, as objective features of social support are related but distinct from these more subjective aspects of social relationships. Loneliness is an unpleasant and distressing experience resulting from a perceived deficiency in the quantity or quality of one's social relationships (Hawkey, 2015). While social isolation can be measured objectively, loneliness is a subjective emotional state of the individual, which may be present in individuals with large social networks, and absent in isolated individuals with minimal social contact (Macdonald, Jackson, Hayes, Baglioni, & Madden, 1998).

Loneliness has been associated with depression and suicide ideation (Heinrich & Gullone, 2006), lower life satisfaction (Schumaker, Shea, Monfries, & Groth-Marnat, 1993), elevated blood pressure levels (Hawkey, Masi, Berry, & Cacioppo, 2006), increased stress hormone levels (Adam, Hawkey, Kudielka, & Cacioppo, 2006) and a compromised immune system (J. T. Cacioppo, Hawkey, & Berntson, 2003). Loneliness has also been linked to an increased tendency to experience subclinical and clinical hallucinations (Meltzer et al., 2013; Myin-

Germeys, Nicolson, & Delespaul, 2001) and to nonclinical paranoid thinking (Freeman et al., 2008; Riggio & Kwong, 2009).

There are a number of possible mechanisms linking loneliness to psychotic symptoms such as hallucinations. For example, loneliness may directly increase anxiety and depression (Heinrich & Gullone, 2006) which in turn may exacerbate symptoms of psychosis (Freeman & Garety, 2003). Loneliness may also perpetuate negative beliefs about oneself and other people, which may in turn increase the frequency of paranoid thoughts. Another pathway may involve ‘anthropomorphism’, whereby social isolation and feelings of loneliness might lead to increased human agency detection in one’s immediate environment, therefore increasing likelihood of hearing voices or perceiving human agency in non-human stimuli (Epley, Akalis, Waytz, & Cacioppo, 2008). This relationship may also work in the other direction, whereby psychotic symptoms lead one to experience feelings of exclusion and stigma, which in turn increases likelihood of feeling lonely. Some authors report case-studies where hallucinating patients actually perceived their imaginary companions as helpful in managing their sense of loneliness (Hutton, Morrison, & Taylor, 2012). Similar findings have been reported with otherwise healthy children who have imaginary companions (e.g. Majors, 2013).

Although there has been much focus on the co-occurrence of loneliness and psychosis, their relationship is still unclear. While there is a consensus that loneliness is a prominent feature in psychosis, some researchers report correlations of near zero between psychotic symptoms and loneliness (e.g. Świtaj, Grygiel, Anczewska, & Wciórka, 2014). Additionally, while some authors report a high prevalence of loneliness in people with psychosis (e.g. Meltzer et al., 2013), this conclusion is often derived from a single-item measure of loneliness, rather than a valid and reliable instrument, which might lead to confusion and limited replicability of studies. There also appears to be no gold standard in regards to how single-item measures are conceptualised and interpreted, with various authors asking for feelings of loneliness across the past week, past 2 weeks or past 12 months, or taking a measure of the number of ‘lonely days in a week’. Some researchers divide Likert scale measures of loneliness into a dichotomous measure, while others keep it as a continuous variable.

Improving our understanding of the relationship between psychosis and loneliness has important theoretical and practical implications. In order to design effective interventions for loneliness, and potentially enable services to best organise their resources to support the wellbeing of individuals with psychosis, a deeper understanding of the nature of loneliness and

its impact on mental functioning in this population is needed. An important first step is to provide a definitive estimate of the magnitude of the relationship, taking into account study quality. Whether the results depend on the way loneliness is measured is also important to consider, both for interpreting the available evidence and for planning future research. Therefore, the primary aim of the current study is to provide a systematic review and meta-analysis of the association between loneliness and psychotic symptoms in people with psychosis.

METHOD

Search Strategy

The electronic databases (PsycINFO, MEDLINE, EMBASE and Web of Science) were searched up to February 2016 using the following terms: (psychos* or schiz* or halluc* or paran* or delus* or psychotic) AND (lonel*) AND/OR (at risk or ultra high risk or clinical high risk or UHR or CHR or prodrom* or psychosis risk or psychosis transition or psychosis onset). Screening was undertaken independently by two authors (B.M., E.V.) First, titles and abstracts were screened, followed by the full text of remaining articles. Hand searches of references in eligible articles and key review articles were also undertaken. Conference abstracts and theses identified through the searches were also followed-up. All corresponding authors of selected papers were contacted (where possible) regarding any unpublished work they were involved in that could be suitable for the purpose of the current review.

Inclusion and exclusion criteria

Studies were eligible for inclusion if they (1) measured psychotic symptoms and loneliness in people experiencing psychosis, (2) measured loneliness symptoms in people diagnosed with psychosis and provided a suitable control group.

For the purposes of this review we defined loneliness as dissatisfaction with the desired and actual number or quality of social relationships (Peplau, 1982). While social isolation can be an objectively quantifiable variable, loneliness is a subjective emotional state of the individual, which may be present in non-isolated individuals with large social networks, and absent in isolated individuals with minimal social networks, and thus involves necessarily subjective measurement.

We defined psychotic disorders as severe mental disorders that cause abnormal thinking and perceptions and included studies that involved people diagnosed with schizophrenia, schizoaffective disorder, schizotypal personality disorder, bipolar disorder with psychotic features, depressive psychosis, delusional disorders and other non-organic psychosis. These included both long-term, established psychosis and first-episode psychosis.

Design

A range of study designs was suitable for inclusion, such as case-control studies, where the cases may be defined either by the presence or absence of psychosis, cross-sectional correlational studies and prospective designs where the relationship between psychosis and loneliness was examined over time. We did not include qualitative studies.

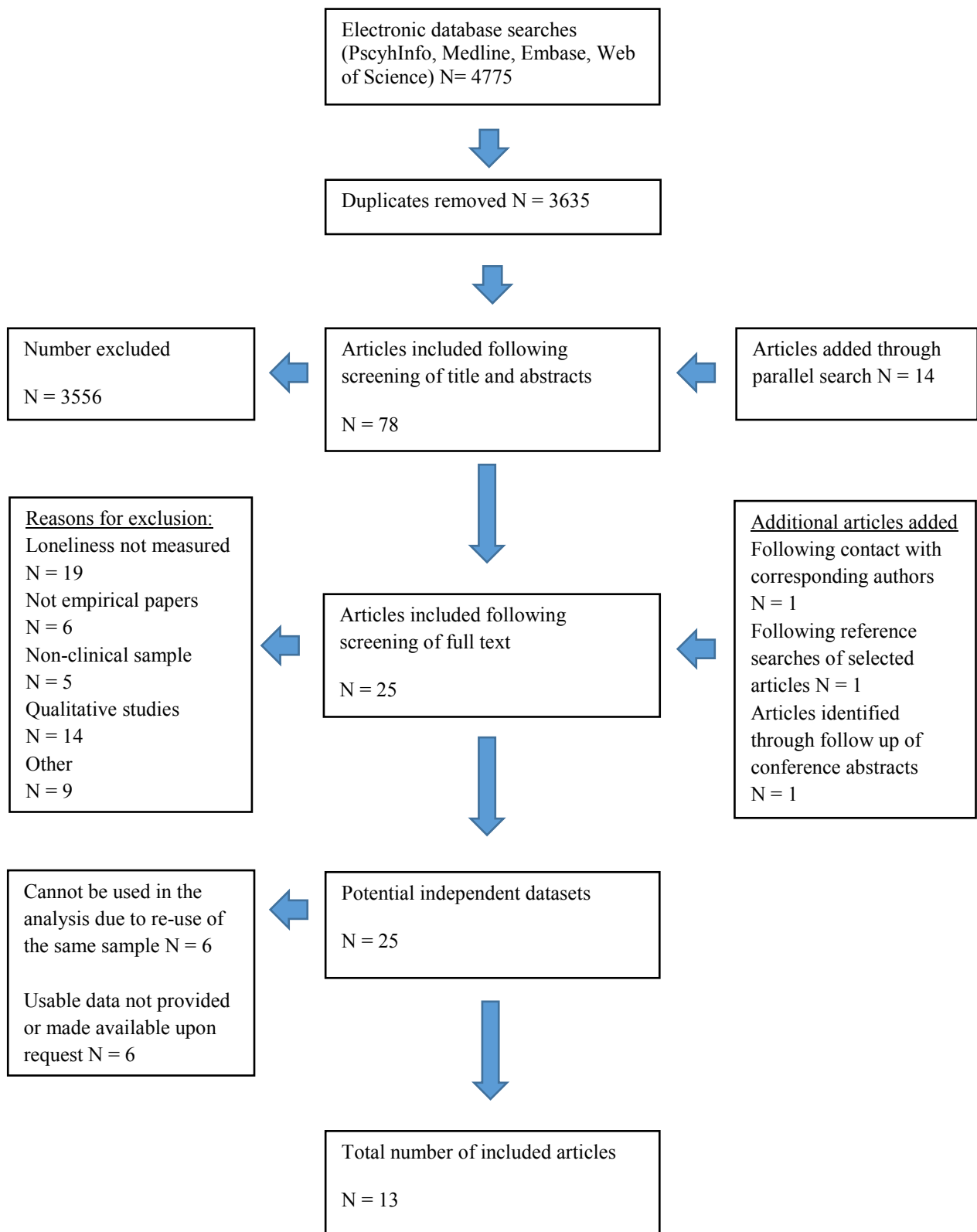
Additional criteria

Only English language articles were included. We did not include studies that did not provide sufficient information for our analysis. For example, studies were excluded if they reported only mean loneliness scores for a group of people with psychosis, but did not involve a control group and did not make a dichotomous distinction (lonely vs not lonely). We also did not include papers where a control group was used, but it was not representative of general population (e.g. self-reported lonely people from the general population).

Data extraction

Extraction of study details was undertaken by one author (BM) using a pre-specified data collection form. In case of any uncertainty articles were discussed further with other authors (PH, SR). In two cases additional information regarding unpublished studies was obtained from authors (Switaj, personal communication; Ludwig, personal communication). In another case further information regarding a relevant study was obtained from authors (Roe, Mashiach-Eizenberg, & Lysaker, 2011), while in six cases further information was needed but contact could not be established with the corresponding author (Borge, Martinsen, Ruud, Watne, & Friis, 1999; C. I. Cohen, Talavera, & Hartung, 1997; Pješpiü et al., 2014; Tylova, Ptáček, & Kuželová, 2013; van der Werf et al., 2010; Young, Snyder, & Schactman, 2015). All relevant statistics were estimated from available datasets, with missing cases excluded. In longitudinal studies where correlation between psychotic symptoms and loneliness were reported across different time points, an average correlation was calculated. Similarly, for studies where correlations were reported for separate subscales of psychotic experiences, an average raw correlation was calculated. Where effect size transformation was required, guidelines in (Borenstein, Higgins, & Rothstein, 2009) were followed.

Figure 1. Prisma Chart



Methodological quality

The methodological quality of studies was assessed using an adapted version of the Agency for Healthcare Research and Quality (AHRQ) tool (Williams, Plassman, Burke, Holsinger, & Benjamin, 2010). The assessment of all included studies was done by the lead author (BM). In order to ascertain that the quality assessment was accurate, a proportion of papers (6) was also independently assessed for quality by another author (EV) with an inter-rater reliability of 80%, and any disagreements resolved by a third author (PH). The devised quality criteria checklist followed closely from Taylor, Hutton, and Wood (2015). Studies were rated on a number of methodological parameters as either fulfilling the criteria in full, partially or not fulfilling it. A copy of this adapted measure is attached as Appendix B.1.

The overall quality of the final outcome was assessed using an adapted version of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach (GRADE Working Group, 2007). The general GRADE rating includes review of quality of data, publication bias, inconsistency and imprecision and produces the final grade of either high, moderate, low or very low quality. General data quality was assessed by using the AHRQ reports for studies contributing to that specific outcome. Publication bias was assessed using funnel plot, Egger's regression test and the Rank correlation test. Inconsistency was assessed via assessment of heterogeneity and overall direction and magnitude of effect, and imprecision was assessed via assessment of effect size, confidence intervals and overall number of participants contributing to the analyses. The specific criteria that were used for making AHRQ and GRADE ratings are detailed in the appendices B.1 and C.1.

Registration of Protocol and Subsequent Changes

The review protocol was registered and published in the public domain (PROSPERO Registration CRD42016015371, see appendix D.1) before searches, data extraction and analysis were conducted. Subsequent changes included narrowing the research question from psychosis continuum to people with established psychosis and addition of a second person to conduct the search in parallel. In addition, a decision was made to run the meta-analysis on correlational data rather than odds ratios. This decision was made once papers were screened in full and it became apparent that majority of the included studies reported correlations; it therefore seemed more appropriate to convert effect sizes to the one most commonly reported in our specific pool of studies, therefore reducing reliance on potentially untested assumptions. Due to insufficient data, it was decided to drop a comparison between people diagnosed with

psychosis and those with other non-psychotic mental health problems or at risk of developing psychosis. Finally, we performed an additional moderator analysis to examine whether the results were affected by stage of illness of study participants.

Data synthesis and analysis

For each of the studies, a correlation coefficient (r) of the relationship between psychosis and loneliness was computed. Data conversion was conducted in accordance with guidelines in Borenstein et al. (2009). Converting effect sizes into one metric allows continuous and binary data from a range of different measures reported in a range of different study designs to be combined, thus increasing the efficiency and power of the analysis. These correlation coefficients were then transformed into Fisher's z scale and entered into a random-effects meta-analysis. Meta-analysis was conducted with a use of R version 3.2.3, package: Metafor (Viechtbauer, 2010).

RESULTS

Study characteristics

As shown in Figure 1, there were 13 eligible studies, reported data related to 15,647 participants. Study characteristics are presented in Table 1. Two studies were conducted on people with first onset psychosis and one related to people with late onset psychosis, while the remaining ten assessed people with established psychosis. Nearly all of the studies employed a cross-sectional design. Studies originated from a variety of countries including the USA, Great Britain, Australia, Germany, Israel and Poland. A list of excluded studies, with reasons for exclusion, is provided in the appendix E1.

Study quality

The assessment of study methodological quality is outlined in Table 2. The most prevalent methodological weaknesses related to justification of sample size, reporting of how missing data was handled and ascertaining an appropriately matched control group. Studies varied in how the psychotic symptoms were reported, with some studies reporting presence of diagnosis of psychosis only, while others reported scores on validated measures of psychotic symptoms such as BPRS or SANS/SAPS. This, however, is partially related to the fact that not all of the studies were designed to answer the specific question of the current meta-analysis. Four studies measured loneliness with a single-item measure. Only one study reported a power calculation (Sündermann, Onwumere, Bebbington, & Kuipers, 2013). Most studies provided adequate information regarding sample characteristics and used valid and reliable measures to rate loneliness and psychotic symptoms.

Outcome quality

Based on the GRADE criteria we downgraded the overall outcome by 1 point due to the high heterogeneity as indicated by the I^2 statistic and estimated the quality of the final outcome as moderate (please see appendix C1 for more detail).

Table 1. Characteristics of included studies

Authors, year, Country	Groups included in review / Design	N participants	Age, mean (SD)	Proportion male (%)	Recruitment source	Ethnicity	Psychotic symptoms measure	Loneliness measure
Angell et al., 2002, USA	adults with schizophrenia schizoaffective disorder schizotypal personality disorder total <i>longitudinal design</i>	61 21 2 87	20-24 n=44 25-29 n=26 30-32 n=17 mean age not reported	62/87 (71%)	Evaluation of the Program of Assertive Community Treatment (PACT)	Caucasian (95%) African-American (4%) Latino (1%)	18-item version of the Brief Psychiatric Rating Scale	1-item scale: Loneliness defined as the number of days (range = 0-7) in which the subject reported feeling lonely and in need of companionship during the week preceding the interview
Badcock et al., 2015, Australia (also: Stain et al 2012)	Schizophrenia Schizoaffective disorder Bipolar disorder with psychotic features Depressive psychosis Delusional disorders and other non-organic psychosis Total Authors referred to a similar survey conducted on general population in New Zealand as a control group / <i>cross-sectional</i>	835 287 314 80 87 1603	Not lonely 37.5 (11.4) Lonely 38.3 (10.9)	979/1603 (61%)	The second Australian National Survey of Psychosis	Not reported	No measure/ Diagnostic Interview for Psychosis Diagnosis	1-item scale: "In the last 12 months have you felt lonely?" 4-point scale: (1) I have plenty of friends and have not been lonely; 2) Although I have friends I have been lonely occasionally; 3) I have some friends but have been lonely for company; 4) I have felt socially isolated and lonely.
Gayer-Anderson et al., 2014, England conference abstract	first-presentation psychosis cases unaffected population-based controls	227 199	Not reported	Not reported	the Childhood Adversity and Psychosis (CAPsy) Study	Not reported	Not reported	Not reported
Giblin et al., 2004	people with a diagnosis of late-onset psychosis (LOP) late-onset depression (DEP) healthy older volunteers (HEV;) <i>cross-sectional design</i>	14 13 18	77.7 (6.6) 76.1 (6.4) 73.4 (7.8)	2/14 5/13 3/18	Patients: recruited via mental health teams controls: recruited from local community sources.	Not reported	No measure/ diagnosis instead	'Lonely dissatisfaction' item on Philadelphia Geriatric Center Morale Scale (higher score – higher morale)

Authors, year, Country	Groups included in review / Design	N participants	Age, mean (SD)	Proportion male (%)	Recruitment source	Ethnicity	Psychotic symptoms measure	Loneliness measure
Lindner et al., 2014 Germany	schizophrenia patients	36	30.8 (7.9)	22/36	psychiatric in-patients	Not reported	SANS and SAPS	multidimensional loneliness questionnaire (Multidimensionaler Einsamkeitsfragebogen; MEF)
	healthy controls <i>cross-sectional design.</i>	40	29.5 (8.3)	27/40	controls: not reported			
Ludwig et al., 2013 USA Conference abstract –unpublished study	Persons with schizophrenia	34	34.1 (9.0)	23:11	recruited from a pool of potential participants within the Brain Behavior Laboratory at the University of Pennsylvania	Not reported	SAPS, SANS	Revised UCLA
	Controls <i>cross-sectional design.</i>	33	32.5 (11.2)	22:11				
Meltzer et al., 2013. England (also; Shevlin et al., 2015, Boyda et al., 2015 and McManus et al., 2009)	‘probable psychosis’ of schizophrenia or affective disorder <i>cross-sectional design.</i>	23	Not reported	Not reported	adult psychiatric morbidity survey 2007	Not reported	no measure / diagnosis based on SCAN (Schedule for Clinical Assessment in Neuropsychiatry)	1-item “I feel lonely and isolated from other people” (over the past 2 weeks) Likert scale ranging from “1–Not at all” to “4–Very much”.
Roe et al., 2011 Israel	People diagnosed with schizophrenia or schizoaffective disorder <i>cross-sectional design</i>	159	43.2 (10.7)	66.7% men	psychiatric rehabilitation residential centers	Not reported	Modified BPRS-E	Social and emotional loneliness scale—short version (S-SELAS)
Stein et al., 2013 USA	young adults diagnosed with schizophrenia or bipolar disorder	30	23.7 (2.75)	18 men, 12 women	Participants were part of a longitudinal research project that examined life course changes for individuals and families coping with serious mental illness.	Proportions in both samples were the same: Caucasian (80%) African American (20%).	no measure/ diagnosis	UCLA Loneliness Scale.
	parents of these young adults <i>cross-sectional design</i>	30	50.3 (7.4)	28 mothers, 2 fathers				
Sundermann et al., 2014, England	individuals with a first episode in psychosis <i>cross-sectional design</i>	38	23/38 (60.5%)	32.3 (9.6)	NHS outpatient services within a South London NHS Foundation Trust	Caucasian 20 (52.6 %) African American 13 (34.2 %) Other 5 (13.3 %)	SAPS, SANS	1-item measure ‘how many days have you felt lonely and in need of companionship in the past week?’

Authors, year, Country	Groups included in review / Design	N participants	Age, mean (SD)	Proportion male (%)	Recruitment source	Ethnicity	Psychotic symptoms measure	Loneliness measure
Switaj et al., 2014, Poland (also: Switaj et al., 2015, and Wciorka et al, 2015)	Patients with psychotic disorders <i>cross-sectional design</i>	110	38.4 (11.4)	43/110 (39.1%)	Mental health care facilities in Warsaw	Not reported	BPRS	A short version of the De Jong Gierveld Loneliness Scale (DJGLS)
Switaj et al, 2016, Poland (in press)	patients with psychotic disorders (ICD-10 categories: F20-F29) control group	207 207	Not reported	Not reported	Not reported	Not reported	18-item BPRS.	11-item De Jong Gierveld Loneliness Scale
Tietjen, 1993, USA	No clinical diagnosis	87	Range: 24-59, mean/sd not reported	24/87 (30.8%)	Patients receiving treatment at psychiatric hospital	Non clinical Black: 10.4% White 89.6%	SCL-90-R Symptom checklist 90 revised	ESLI, Emotional & Social Loneliness Inventory
	Diagnosed with affective disorder	92		29/92 (36.3%)	Controls: students of general studies	Affect. Disor. Black:13% White: 87%		
	Diagnosed with schizophrenia (DCM III)	93		45/93 (57.7%)		Schizophrenia Black:16.2% White: 83.8%		

Table 2. Assessment of study quality

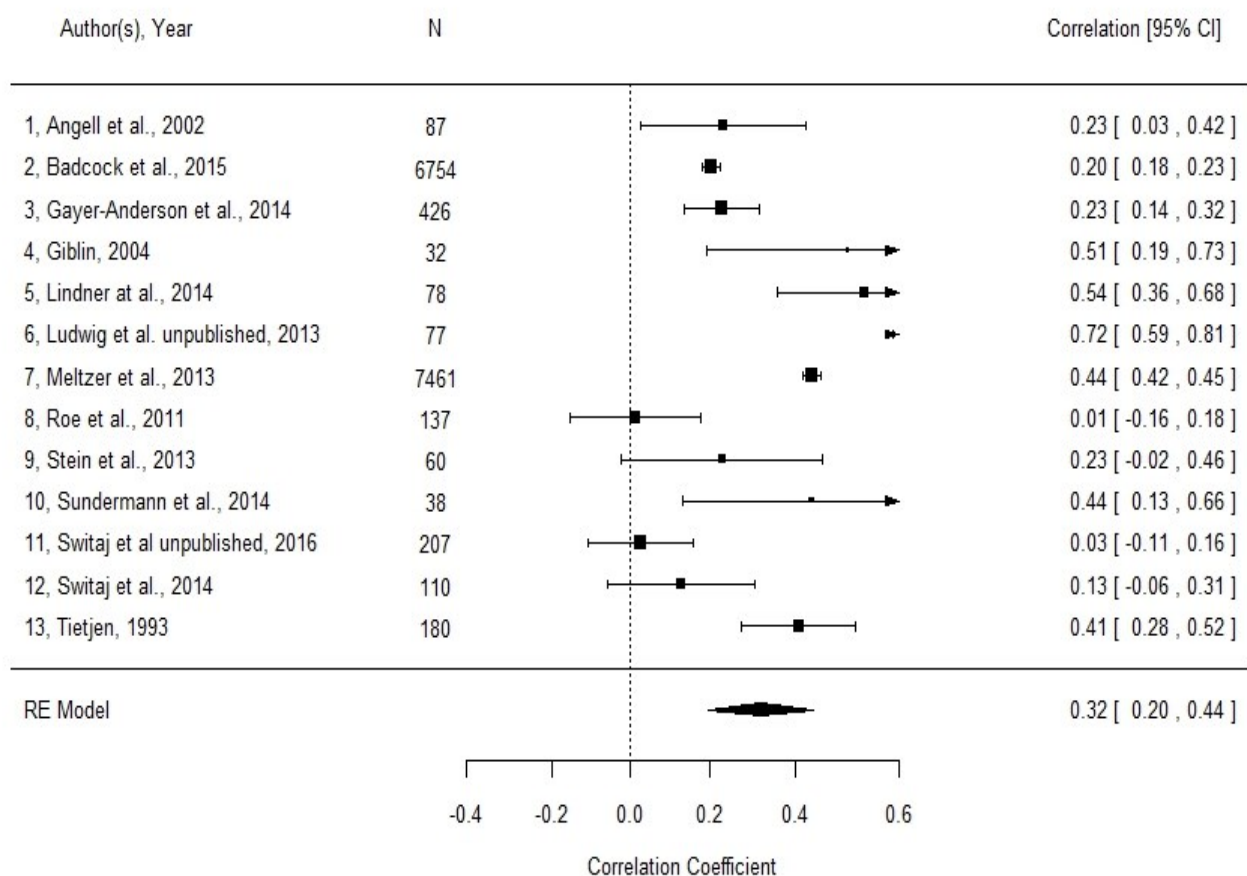
Study Ref	Unbiased Selection of the cohort	Selection Minimises Baseline Differences in Prognostic Factors?	Sample Size Calculated?	Adequate Description of the Cohort?	Validated Method for Ascertaining Psychotic Symptoms	Validated Method for Ascertaining Loneliness	Adequate handling of missing data
Angell et al., 2002	partial	yes	no/not reported	yes	yes	no	yes
Badcock et al., 2015	Yes	partial	n/a	yes	yes	no	yes
Gayer-Anderson et al., 2014 (conference abstract)	not reported	not reported	no/not reported	not reported	not reported	not reported	not reported
Giblin et al., 2004	partial	partial	no/not reported	partial	yes	yes	not reported
Lindner et al., 2014	unclear	not reported	no/not reported	partial	yes	yes	not reported
Ludwig et al., 2013 unpublished	partial	yes	no/not reported	partial	yes	yes	not reported
Meltzer et al., 2013	Yes	yes	n/a	yes	partial	no	no
Roe et al., 2011	partial	n/a (no control group)	no/not reported	yes	yes	yes	yes
Sundermann et al., 2014	partial	n/a (no control group)	yes	yes	yes	no	yes
Stein et al., 2013	partial	no	no/not reported	yes	partial	yes	not reported
Switaj et al., 2014	partial	n/a (no control group)	no/not reported	partial	yes	yes	not reported
Switaj et al, 2016 – in press	not reported	yes	no/not reported	Not reported	yes	yes	not reported
Tietjen, 1993	partial	no	no/not reported	yes	yes	yes	not reported

Association between loneliness and psychotic symptoms

There was moderate quality evidence (see appendix C1) suggesting a significant moderate association between psychosis and loneliness (Fisher's z estimate = 0.33, SE = 0.07, z -value = 4.81, $p < .001$, 95% CI: 0.1981, 0.4704). These values were converted back to correlation coefficient which produced the estimate of $r = 0.32$ (95% CI: 0.20, 0.44) which is considered a medium effect size, according to Cohen's criteria (J. Cohen, 1992).

The I^2 statistic was 97.56% indicating that the majority of variation in the estimated effect sizes reflected actual differences in the population mean (95% CI: 94.42, 99.20, $Q(12) = 316.43$, $p < .001$). A Baujat plot suggested that one study (Ludwig et al., unpublished) was influential in its contribution to the overall heterogeneity and the overall result. However, because exclusion of this study did not lead to a reduction in the proportion of true heterogeneity ($I^2 = 95.93$, 95% CI: 89.62, 98.83) nor did it significantly change the overall effect size ($r = 0.28$, 95% CI: 0.17, 0.38), consequently it was decided to keep it in the meta-analysis.

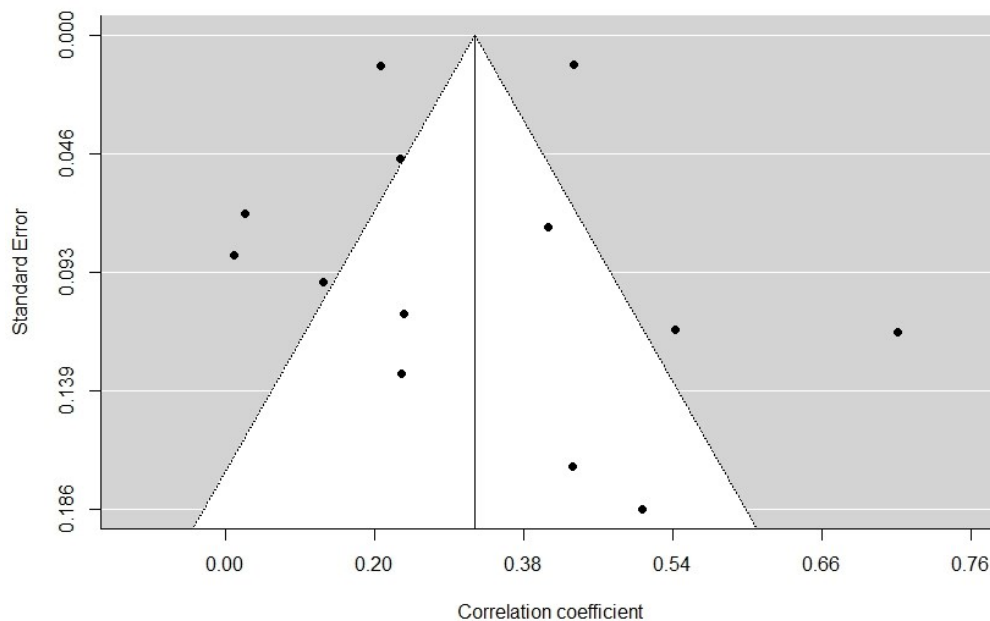
Figure 2. Forest plot



Publication bias

Although a funnel plot of effect size against standard error (Figure 3) appeared to be asymmetrical, neither Egger's regression test ($p = 0.29$) nor the Rank correlation test ($p = 0.13$) was statistically significant. Overall then, there was no clear evidence of publication bias according to these tests.

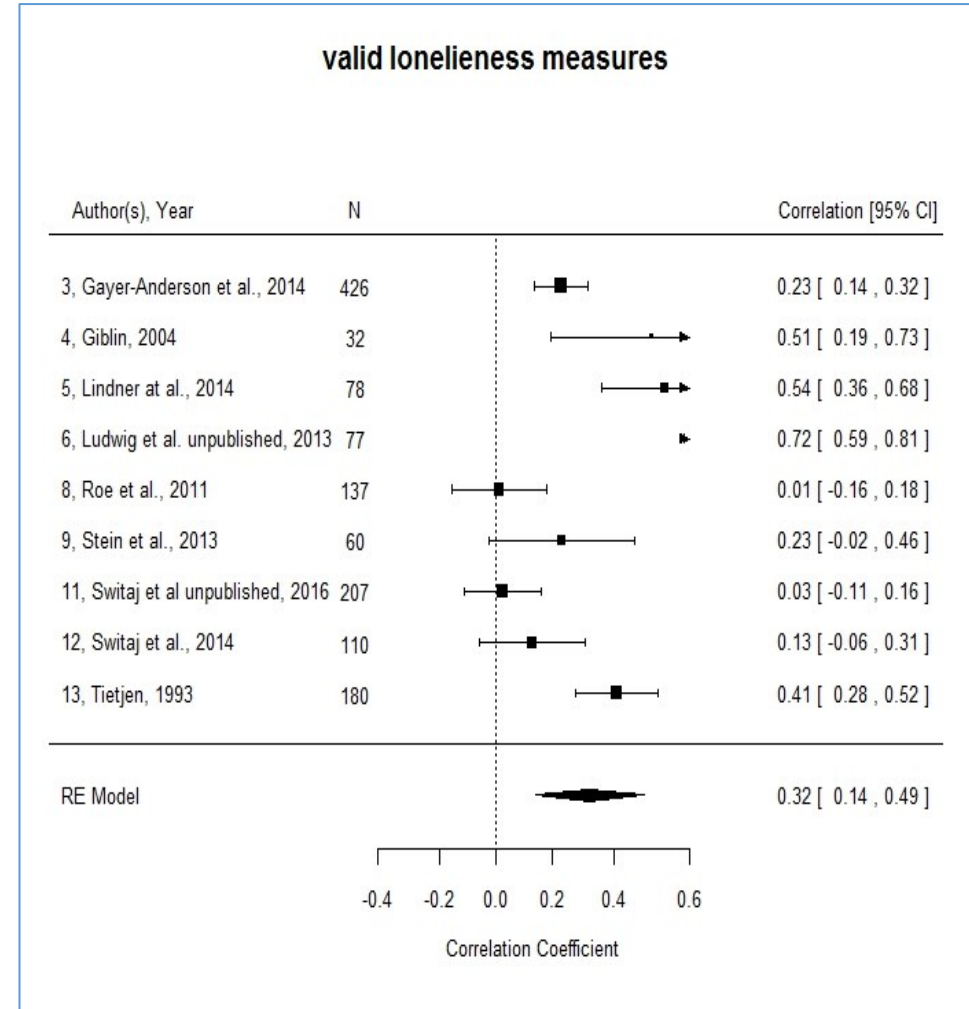
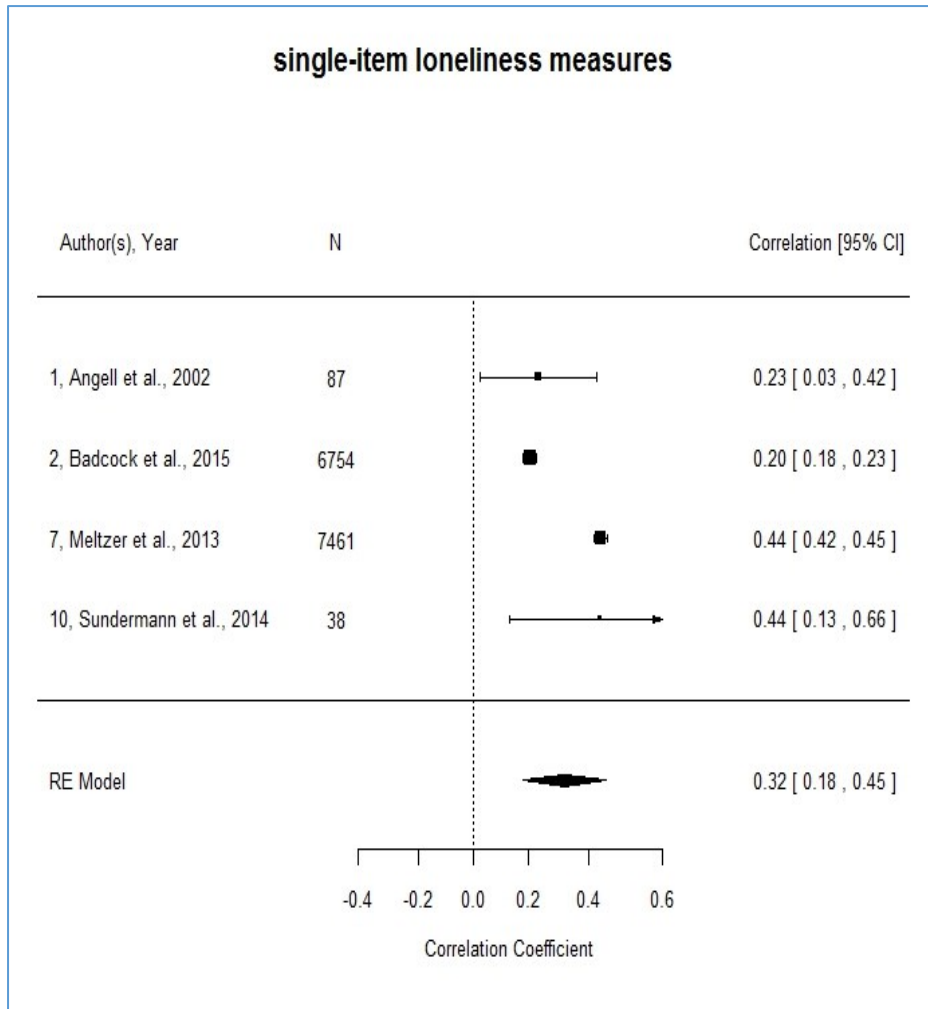
Figure 3. Funnel plot



Moderator Analyses

Whilst blinding of researcher to participant status (e.g. psychosis or control) had been pre-specified as a potential moderator of interest, none of the studies reported using blinding, therefore this analysis was not possible. Results of the moderator analysis for single-item vs comprehensive self-report measure of loneliness was not significant ($Q(1) = 0.001$, $p = 0.97$). As Figure 4 illustrates, there was no evidence that studies that employed very brief measures of loneliness produced different estimates to studies using more comprehensive assessments. We also examined whether the results were affected by stage of illness (first onset/late onset [$k = 3$] versus established psychosis [$k = 10$]), and found no significant differences ($Q(1) = 0.01$, $p = 0.92$).

Figure 4. Sensitivity analysis



DISCUSSION

The current analysis confirms that there is a significant relationship between loneliness and psychotic symptoms in people with psychosis. This finding is in line with growing evidence that loneliness is a common feature in psychosis (Badcock et al., 2015; Meltzer et al., 2013) and should be considered in further conceptualisations of psychotic disorders and treatment planning.

Could loneliness cause psychotic symptoms?

While the evidence from the current analysis supports the concept of psychosis and loneliness being significantly inter-related, the nature of this relationship is still unclear. Gayer-Anderson and Morgan (2013) postulated the self-preserving cycle of psychosis and loneliness, and suggested that loneliness played a maintaining role in psychotic experiences; however, it is also possible that loneliness might serve a crucial role in psychosis onset (van der Werf et al., 2010). The concept of a psychosis phenotype can be expressed at levels below its clinical manifestation, commonly referred to as psychosis proneness, psychotic experiences, schizotypy or at-risk mental states (Van Os, Hanssen, Bijl, & Ravelli, 2000; Yung et al., 2003). It therefore seems likely that loneliness might be inter-related to psychotic symptoms at earlier, subclinical stages of psychotic presentation. A cognitive model of psychosis proposed by Garety, Kuipers, Fowler, Freeman, & Bebbington (2001) suggests that one of the pathways to the development of psychosis might be via poor self-concept and self-esteem (Kinderman & Bentall, 1996; Trower & Chadwick, 1995) which might impact on maladaptive cognitions of self and others. Self-esteem is poor in many people with psychosis (Freeman et al., 1998) while hallucinations and delusions that have negative content are associated with negative self-concepts (Close & Garety, 1998). It would be reasonable to assume that feelings of loneliness can strengthen negative self-concepts and impact negatively on self-esteem. Garety et al. (2001) suggest that psychotic beliefs are likely to be more rigidly held if they are consistent with firmly-held distorted beliefs about the self (e.g. that one is different or inferior), others (e.g. that others are hostile) and the world (e.g. the world is dangerous). In other words, this cognitive model would fit well with the hypothesis that loneliness could increase psychotic symptoms.

While some authors propose that loneliness mediates the development of psychotic symptoms (e.g. Boyda, McFeeters, & Shevlin, 2015; van der Werf et al., 2010), others suggest that

loneliness might be secondary to psychotic experiences. Riggio and Kwong (2009), for example, reported that deficits in social skills and paranoid thinking independently predicted greater loneliness and fewer social supports in otherwise healthy individuals. Further studies aimed at investigating the occurrence and role of loneliness across the psychotic continuum would be helpful in determining whether it precedes the onset of psychosis or occurs as a result of the condition. In particular, studies of experimental design with loneliness as the manipulated variable would be helpful in establishing whether there is a casual relationship.

Single-item loneliness measures

The findings of the moderator and sensitivity analyses regarding the type of loneliness measures used supports the idea that a single item loneliness measure produces results in line with those acquired using valid and reliable instruments. It seems important, however, to highlight that the way the single-item measures are used is usually influenced by the type of study conducted. They seem particularly prevalent in surveys, where participants respond to a large number of questions and the analysis of findings might be exploratory, rather than set out to test a primary hypothesis. There is a risk in interpreting results obtained in this fashion, as no reliability is guaranteed with single-item measures, while the large number of responders is likely to produce significant effects. One example of how unreliable single-item measures might be is provided in Angell and Test (2002), where in their longitudinal design researchers took measure of loneliness across different time points (using a single-item measure). The correlation in endorsement of state loneliness between two time points (at 18 months after study entry, and then at 24 months) was $r = .14$, whereas the correlation on a valid measure of thought disturbance at these time points was $r = .45$. Although this may reflect inherent instability in state loneliness rather than poor reliability, it is important that results from single-item measures are considered with care.

Implications for clinical practice

Some authors suggest a link between loneliness and recovery from psychosis. Jackson et al. (2008) compared the effectiveness of Active Cognitive Therapy and Befriending in reduction of psychosis symptoms and functional improvement in people with first episode of psychosis. They reported equal effectiveness of the two treatments, which is suggestive of a significant role of befriending in psychosis recovery. This finding is congruent with findings of Roe et al. (2011) who reported that patient's subjective recovery from psychosis was significantly

associated with a decrease in loneliness. It therefore appears that increased loneliness may play a role in the maintenance of psychosis, but also that a decrease in loneliness may be related to subsequent recovery. However, the results of the Adult Psychiatric Morbidity Survey in England (Meltzer et al., 2013) suggest that traditional approaches to reducing loneliness, such as increased social support and participation, had only a limited effect on subjective loneliness. This raises the possibility that these strategies, which are often applied in order to reduce loneliness in people with psychotic disorders, might not be very effective. Badcock et al. (2015) reported that loneliness amongst people with psychotic disorders was particularly associated with thought disturbance and reduced sense of pleasure. Thus, increasing possibilities for social interaction might not always be effective; if one does not derive pleasure from social contact or has negative cognitions related to social participation, then a positive outcome of the intervention is unlikely. In addition, having a confidante has been associated with lower levels of loneliness (Green, Richardson, Lago, & Schatten-Jones, 2001) which would be suggestive of the importance of the quality of interaction rather than the quantity. It thus seems essential that in clinical practice particular attention is given to loneliness and the maintaining role it might have in psychotic experiences. It is important to consider that patients with psychosis are often longing for social contact but lacking resources to build and maintain them. Consequently, treatment options might involve changing maladaptive cognitions (S. Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015), while at the same time providing high quality social contact. Indeed, this may be one reason why the therapeutic relationship has been found to be such a crucial factor in ensuring effective and safe psychological therapy for psychosis (Goldsmith, Lewis, Dunn, & Bentall, 2015).

Strengths and limitations

We decided, a priori, to adopt a deliberately inclusive approach for this meta-analysis. Although this is recommended (Berman & Parker, 2002) and although it ensures we made the best use of the limited studies available, the cost is inevitably considerable heterogeneity between studies in terms of population (including stage of illness), methodological design and quality. It may be argued that limiting the analysis to studies that look at one particular type of psychotic disorder, or at one particular population (e.g. late onset only, first episode only) may have increased the homogeneity of the results – thus giving us confidence that any residual heterogeneity was not attributable to these factors. However, an inclusive approach to meta-analysis is arguably more transparent and informative. Unlike a more restrictive meta-analysis,

this approach minimises the number of a priori assumptions we have to make about moderating factors, and instead allows us to produce empirical data on the effect of excluding such subgroups. Indeed, we found no evidence that stage of illness acted to moderate the overall effect, which suggests the observed relationship between psychosis and loneliness is a robust one.

Studies of various types of psychotic disorders were included in our meta-analysis. This reflects our decision to operate with a broad definition of psychosis, rather than focus on specific symptoms. However, we note that negative symptoms such as withdrawal or loss of pleasure are significantly different to positive symptoms such as hallucinations and delusions. For example, Badcock and colleagues reported data on twelve specific symptoms, including delusions, hallucinations, thought disorder, passivity etc. and found significant correlations with loneliness only for two of them (thought disorder and loss of pleasure) (Badcock et al., 2015). Although our meta-analysis provides important data on the nature of the psychosis-loneliness relationship, future meta-analyses may benefit from adopting a symptom-specific approach. Their results may present less heterogeneity as a consequence, and the value of such work for understanding the onset and maintenance of specific psychotic symptoms may be high.

It is also important to consider that our quality assessment relates very much to the hypothesis we are testing. Although we criticised the quality of several of the included studies, we did this simply so that we could form a view as to the reliability of the estimate. We fully recognise that many of the studies did not set out to examine the link between psychosis and loneliness, and often only reported loneliness data as a secondary outcome.

Some of the included studies reported adjusted odds ratio only (Meltzer et al., 2013) which further complicates the analysis, for various authors adjust for different parameters and this leads to difficulty in interpreting the synthesised results. Nonetheless, there was no evidence that the overall effect was moderated by these individual studies.

Although tests of publication bias were not significant, it is possible that this was due to a limited number of studies included in this analysis (Ioannidis & Trikalinos, 2007). A visual inspection of the funnel plot did suggest that small studies reporting limited or no relationship between psychosis and loneliness may be lacking. Publication bias is of course an endemic problem (Joober, Schmitz, Annable, & Boksa, 2012) and, as with clinical trials, pre-registration

of empirical research could help to reduce – or at least measure – non publication of non-significant results (Joober et al., 2012).

Six studies that appeared relevant for the current analysis were not included due to difficulty in obtaining usable data. In addition, we did not include studies that were not published in English. Non-inclusion of studies is of particular concern in systematic reviews of observational studies as there is inevitably a greater threat of publication bias with this sort of research than, for example, treatment effectiveness research (Easterbrook, Gopalan, Berlin, & Matthews, 1991). On the other hand, we were not completely unsuccessful in acquiring unpublished data or information; in fact, three authors replied to our queries meaning we were able to include data from 13 studies, instead of 10.

A particular strength of our review and meta-analysis is that we sought to pre-register the hypotheses and methodology in the public domain (Booth et al., 2011; Shea et al., 2009). As noted elsewhere (Booth et al., 2011; Quintana, 2015), systematic reviews and meta-analysis are far from immune from risks of selective reporting bias and cases of hypothesising after the results are known. Although we made some changes to our protocol after registering it (largely to reduce scope), pre-registration ensures complete transparency about these, thus allowing readers to judge for themselves whether they are driven by issues relating to feasibility, new information, or bias.

Conclusion

This review and meta-analysis has provided clear evidence that there is a significant relationship, moderate in magnitude, between loneliness and psychotic symptoms in people with psychosis. Although there was high heterogeneity across different studies, the overall relationship was robust. Such a finding is congruent with other evidence, as well as recent theoretical accounts of psychosis (Garety et al., 2001; Hoffman, 2007). This finding should be considered in clinical practice and treatment provision for those with psychotic disorders. However further studies are needed to test the hypothesis that loneliness may cause psychosis. In particular, studies examining the effect of experimentally manipulating loneliness on psychotic symptoms are essential for understanding the causal status and direction of the relationship we have observed here.

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Chapter 2. Empirical Study - Journal Article

The effect of loneliness on proneness to auditory hallucinations and perceiving human-like features in ambiguous visual stimuli: A randomised controlled experiment with older adults

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Abstract

Aims: The aim of the current study is to examine whether, in older adults, feelings of loneliness could lead to an increased proneness to detect words or human-like features in ambiguous auditory and visual stimuli, respectively.

Method: A parallel group experimental design with random allocation to experimental conditions was employed. 62 healthy older people (32 women; mean age = 73.7 years) were assigned to complete either a procedure designed to induce temporary feelings of loneliness (the experimental group) or an emotionally neutral task (the control group). A logistic regression was conducted and odds ratios calculated.

Results: Participants in the neutral condition were significantly less likely to hear words in the ambiguous auditory stimuli (OR = 0.70, 95% CI 0.51 – 0.94, $p < 0.05$). Higher scores on the state loneliness measure were associated with an increase in the likelihood of hearing words (OR=1.17, 95% CI 1.01-1.35, $p = 0.03$). No difference in detection of human-like features in visual stimuli was found.

Conclusions: The current study provides preliminary evidence that in older people increased feelings of loneliness lead to increased likelihood of experiencing subclinical auditory hallucinations.

Keywords: loneliness, isolation, hallucinations, hearing words, human-agency detection, anthropomorphism, older people, older adults.

1. Introduction

Loneliness is an unpleasant and distressing experience, related to perceived deficiency in the quantity or quality of one's social relationships (Hawkley, 2015). While loneliness is most frequent amongst those younger than 25 and older than 65 (Victor & Yang, 2012), it is often considered a problem of older age (Donaldson & Watson, 1996). This might be because of the temporary nature of loneliness in childhood and adolescence, whereas in older age the experience of grief and loss accumulates while the likelihood of creating new bonds decreases (Luanaigh & Lawlor, 2008).

Loneliness is related to the development and exacerbation of physiological changes associated with disease and death (Hawkley & Cacioppo, 2010) including depression and suicidal ideation (Heinrich & Gullone, 2006) elevated blood pressure levels (Hawkley, Masi, Berry, & Cacioppo, 2006), increased stress hormone levels (Adam, Hawkley, Kudielka, & Cacioppo, 2006) and compromised immune system (J. T. Cacioppo, Hawkley, & Berntson, 2003).

In order to reduce the unpleasant feeling of loneliness people engage in a variety of behaviours such as seeking connections with others (Maner, DeWall, Baumeister, & Schaller, 2007), imagining important social relationships (Twenge, Catanese, & Baumeister, 2003), and paying increased attention to social cues in the environment (Gardner, Pickett, Jefferis, & Knowles, 2005). Social disconnection might lead to increased anthropomorphism, where one perceives a human-agent in a non-human stimuli (Epley, Akalis, Waytz, & Cacioppo, 2008). Kirkpatrick, Shillito, and Kellas (1999) report that those experiencing extreme isolation tend to talk to animals or imaginary companions. Some researchers (see: J. T. Cacioppo & Patrick, 2008) propose that loneliness is a biological signal, similar to feelings of hunger or thirst, which helps to ensure that people seek out and maintain social connections.

There is some evidence to suggest that loneliness may be related to an increased tendency to experience subclinical and clinical hallucinations. Loneliness has been linked to a diagnosis of psychosis (Meltzer et al., 2013), and to psychotic experiences (Delespaul & van Os, 2002; Myin-Germeys, Nicolson, & Delespaul, 2001). Some studies reported associations between loneliness and nonclinical paranoid thinking (Freeman et al., 2008; Riggio & Kwong, 2009). Although previously such associations were perceived as reflecting the negative impact of psychotic experiences on social functioning (Møller & Husby, 2000), more recently it was

postulated that loneliness may play a causal role in the development of psychotic experiences (van der Werf, van Winkel, van Boxtel, & van Os, 2010).

Hallucinations are a core symptom of schizophrenia (Oertel et al., 2007). They can be defined as perceptions that take place in the absence of corresponding sensory input, and can occur in all sensory modalities. Auditory hallucinations (AH) are the most common, occurring in up to 70% of psychotic patients (Verdoux & van Os, 2002). Although AH were traditionally associated with psychiatric diagnoses, it is now recognised that they occur on a continuum, ranging from auditory imagery and intrusive and vivid thoughts to fully developed hallucinations of hearing sounds and voices (Johns et al., 2014). This is in line with the concept of a psychosis phenotype, expressed at levels below its clinical manifestation (Van Os, Hanssen, Bijl, & Ravelli, 2000; Yung et al., 2003), commonly referred to as psychosis proneness, psychotic experiences, schizotypy or at-risk mental states.

Cognitive models of psychotic symptoms posit that auditory hallucinations are accompanied by sub-vocalization (Gould, 1949; Green & Preston, 1981) like most normal ‘inner speech’, which is evidenced by the fact that they are blocked by concurrent verbal activity (James, 1983; Margo, Hemsley, & Slade, 1981). The general consensus of these models is that auditory hallucinations occur when internal events, such as intrusive thoughts or inner speech, are misattributed to an external agent (e.g. R. P. Bentall, 1990; Hoffman, 1986; Waters, Woodward, Allen, Aleman, & Sommer, 2012). The role of appraisal and other top-down mechanisms such as attention, cognitive control capacity, prior knowledge/experience and emotional processes are central in influencing the meaning, form and content of AH (Waters et al., 2012).

The process of differentiating between internal, self-generated events and external, non-self-generated events can be referred to as reality discrimination (Varese, Barkus, & Bentall, 2011). Previous research on reality discrimination suggests that this ability could be affected by negative affect. For example, inducing negative affect in participants was shown to cause an increase in the number of external misattributions on a standard auditory signal detection paradigm (Hoskin, Hunter, & Woodruff, 2014; Smailes, Meins, & Fernyhough, 2014). Loneliness has been demonstrated to be associated with, yet distinct from, other forms of negative affect (J. T. Cacioppo et al., 2006). Feelings of loneliness often lead to high levels of negative affect (J. T. Cacioppo, Hawkley, & Thisted, 2010) and this may be one way in which

loneliness affects reality discrimination. Hoffman (2007) suggested that periods of social isolation and feelings of loneliness may generate a bias whereby people perceive social information to be present when it is not and postulated that this bias could contribute to auditory hallucinations.

It has been observed that auditory and visual hallucinations might increase with advanced age (Tien, 1991) where aging-related factors such as life-events (loss of a spouse), sensory deficits and neurocognitive degeneration contribute to the occurrence of hallucinations (Grimby, 1993, 1998; Turvey et al., 2001). High rates of hallucinations have been reported amongst bereaving older people, especially during the first year of bereavement, while at the same time feelings of loneliness were reported to be the most persistent problem during that time (Grimby, 1993). Rees (1971) reported that 46% of 293 widows and widowers interviewed experienced post-bereavement hallucinations, which on many occasions lasted for many years.

Given that loneliness is a common feature of older age, with as many as 40 % of those over 65 reporting being lonely at least sometimes, while between 5–15 % of adults in this age group report frequent feelings of loneliness (Hawkley, 2015), and taking into account the psychosocial correlates of loneliness, it seemed relevant to investigate the effect that loneliness might have on psychotic experiences in older people.

The current study will use an experimental design to test the hypotheses that experimentally induced loneliness causes older people to experience subclinical auditory hallucinations and an increased proneness to perceiving human-like features in ambiguous visual stimuli. Thus, the findings serve as a direct test of the theory that increased loneliness leads to a bias towards detecting human agency and social information.

2. Method

2.1. Design

A parallel group experimental design was used. Participants were randomised to either a loneliness induction or a neutral control condition, and the effects of this allocation on proneness to detecting auditory (primary outcome) and visual (secondary outcome) human-like stimuli was assessed.

2.2 Participants

Volunteers were eligible to participate if they were consenting, free from mental illness, neurological illness and developmental disability, aged 65 or over, native English speaking, had normal, or corrected-to-normal, vision, and normal, or corrected to normal, hearing. Participants were recruited via posters distributed on bus stops, in the libraries and social clubs across Edinburgh. G*Power was used to estimate that 62 participants (31 in each group) would provide 80% power to detect a moderate-large difference ($d=0.73$) between the groups on the primary outcome assuming an alpha-level of .05.

2.3. Procedure

The study was granted ethical approval by the University of Edinburgh Ethics Committee. Volunteers were sent a Participant Information Sheet (PIS) for the study and given at least 24 hours to decide whether they wanted to continue with the study. Participants were told that the study investigates elements of hearing and vision in older adults. The PIS also warned volunteers that taking part in the study might make them feel temporarily lonely or upset and advised them not to take part if they predicted that this could be a problem. On the day of data collection participants had an opportunity to familiarise themselves with the PIS again and discuss any issues further before signing the consent form.

Following consent and prior to the experimental module participants were asked to fill in a demographic questionnaire and a screening questionnaire for depression and anxiety (HADS). In order to keep participants blinded to the real purpose of the study, they were asked to fill in a brief questionnaire regarding their hearing ability. Participants were then randomly allocated to either an experimental condition involving a loneliness induction procedure or an emotionally neutral control condition. Block randomisation (6) was carried out with the use of a computer program (obtained from: <https://www.sealedenvelope.com/simple-35>

randomiser/v1/lists). Following the induction, they were then asked to complete a task designed to measure the success of the induction procedure (emotional Stroop). Immediately after this they completed tasks designed to measure their proneness to hearing words in the ambiguous auditory stimuli and detecting visual human-like features.

Once the experimental module was completed, participants were asked to fill in the remaining measures, which, amongst others, included state measures of loneliness, negative affect and positive affect. These were taken as a secondary test of induction success and, to ensure minimal delay between the induction and the JST and Ambiguous Images task, these explicit measures were administered only after the latter were completed. It was predicted that participants in the lonely condition would present with a higher interference effect on the emotional Stroop Task on lonely words and possibly on the negative words relative to the participants in the neutral condition. It was also expected that scores on the state measure of negative affect and loneliness might be elevated amongst participants in the lonely condition, although it was predicted that these measures were less likely to detect effects due to the delay between the induction and their administration.

All participants were fully debriefed and the real purpose of the study was explained to them. They were offered an opportunity to ask questions and talk through any difficulties. They were also given information on local social clubs and support groups. Self-help materials and a ‘mood-repair’ film were available for those who expressed their wish to use them.

2.4. Mood induction

There appears to be no gold standard in loneliness induction procedures. Various authors have used different methods, for example some have manipulated interpretation of scores on the Eysenck Personality Questionnaire to predict a lonely future for participants (Baumeister, Twenge, & Nuss, 2002), whereas others have asked participants to watch a segment from the film *Cast Away* (Epley et al., 2008). Bernstein, Young, Brown, Sacco, and Claypool (2008) applied the method of reliving a situation from the past and reported that this loneliness induction effectively elicits feelings of loneliness. It is commonly agreed that when multiple sensory elements are involved in mood induction they have accumulative effect.

In this study an adaptation of the mood induction procedure applied in other studies (e.g. study two of Pickett, Gardner, & Knowles, 2004; Smailes et al., 2014) was employed. In the loneliness induction, participants were asked to recall and write down an account of a time

when they felt intensely lonely while in the neutral induction they wrote down an account of their journey to the department that day. The instructions were recorded in a calm, female voice, which participants listened to using standard Panasonic headphones. Participants were asked to spend a minimum of 5 minutes on the task and provide as much detail about their experience as they could. Following the reliving task, they were asked to watch a 3-minute-long film, which in the loneliness condition was *'The Lonely Plant'*, a film by Silje Forbes depicting a life of an older, lonely man; while in the neutral condition, they were asked to watch a 3-minute factual film about the weather.

2.5. Emotional Stroop Task

Adapted from S. Cacioppo, Balogh, and Cacioppo (2015) and modified for the purpose of the current study, an emotional Stroop task was used to serve as an implicit measure of the effectiveness of the loneliness induction. This involves the presentation of differentially emotionally-valenced words in different coloured inks, and the participant is asked to name or pick the colour of the words as quickly as possible whilst ignoring their semantic content. The Stroop interference effect is demonstrated by longer reaction time to stimuli; for example depressed patients have been shown to take longer to decide on colours of negative words (Frings, Englert, Wentura, & Bermeitinger, 2010), while anxious persons to the words of threat (e.g. McNally, Riemann, Louro, Lukach, & Kim, 1992) which has generally been accepted as evidence for mood-congruent attentional bias in these states.

After completing mood induction tasks, participants were presented with 40 words appearing in the centre of the screen in different ink-colours and were instructed to indicate the colour of ink by pressing one of four keys labelled with corresponding colour (yellow, blue, green or red). Four blocks of words were used (neutral, lonely, positive, negative), 10 words in each block. The word order and the colour of ink in which they were presented were randomised for each participant. After each response, the word disappeared from the screen and the experiment continued to the next trial. For the information on selection of stimuli please see S. Cacioppo et al. (2015). The time reactions and accuracy of answers were recorded.

Table 1. Neutral, lonely, positive and negative words used in the emotional Stroop.

Neutral	Lonely	Positive	Negative
WALLET	ALONE	BRAVE	ANGRY
GLASS	DETACHED	ENJOY	ANXIOUS
CARPET	DISLIKED	HAPPY	DEPRESSED
CAKE	EXCLUDED	JOY	FEAR
BAND	FOE	JOYFUL	FRUSTRATED
CONCENTRATE	HOSTILE	LUCKY	MISERY
CHAIR	ISOLATED	PLEASED	PANIC
HOLIDAY	REJECTED	PLEASURE	SAD
CUPBOARD	SOLITARY	SUCCESS	STRESS
LAMP	UNWANTED	SURPRISED	VOMIT

2.6. Jumbled Speech Task

A Jumbled Speech Task (JST), adapted from Fernyhough, Bland, Meins, and Coltheart (2007) was used to assess participants' proneness to hear words in ambiguous auditory stimuli. Participants were presented with a recording of a 'jumbled' speech – sliced and reversed speech - and asked to type any words or phrases heard in the speech. See Fernyhough et al. (2007) for details on how the recording was prepared.

Hearing a word or a phrase in the JST is referred to as an imaginary verbal experience (IVE; Fernyhough et al., 2007) and could be perceived an example of a participant identifying social information to be present when it is absent. Previous studies have demonstrated that the more IVEs participants report, the greater their hallucination-proneness (Campbell & Morrison, 2007; Feelgood & Rantzen, 1994). It was predicted that participants who completed a loneliness induction would report more IVEs when completing the JST in comparison to participants who completed a neutral induction.

Participants listened to 24 tracks of jumbled speech, each lasting approximately 4.5 seconds. After each track, they were invited to write down any words or phrases heard in the speech. The total number of meaningful words reported was the dependent variable, with a possibility to score either 0 or 1 on each item. Two independent, blinded judges scored each answer sheet, with an inter-rater agreement of 70%. Discrepant scores were referred to a third judge, also masked to which group each participant had been allocated to.

2.7. Ambiguous images task

Adapted from Epley et al. (2008) this task was used to measure an increased tendency to perceive human-like agents in one's immediate visual environment. This task involves looking at 20 ambiguous pictures and describing in a few words what they present. Half of the pictures vaguely resembles human face, while the other half resembles nothing in particular (see Fig 1). The number of faces and human-like figures spontaneously reported served as our dependent variable. The stimuli for this task was reprinted with author's permission.

Figure 1. Examples of drawings used in this face-detection task.



The two pictures in the top row are examples of drawings resembling faces, while the 2 in the bottom row are created to resemble nothing in particular (reproduced with permission from Epley et al., 2008).

2.8. Additional Measures

Demographic Questionnaire A brief questionnaire was used to establish participants' age, sex, education, marital/ relationship status and current circumstances (whether they live on their own, are in contact with family and friends).

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used as a screening measure of anxiety and depressive symptoms. This measure was found valid and reliable in identifying caseness of anxiety and depression (Bjelland, Dahl, Haug, & Neckelmann, 2002). It consists of 14 items, 7 related to anxiety and 7 to depressive symptoms. The measure was found to demonstrate high validity in assessing symptom severity and caseness of anxiety (HADS-A; with a specificity of 0.78 and a sensitivity of 0.9) and depression (HADS-D; with a specificity of 0.79 and a sensitivity of 0.83) (Bjelland et al., 2002). A score of 16 or greater indicates clinical difficulties and was an indicator for exclusion from the study.

State Measures of Loneliness, Positive Affect and Negative Affect (3 items each). These measures are typical of those used in the Experience Sampling Method (ESM), a repeated self-assessment technique. The state measures of negative and positive affect were adapted from Myin-Germeys et al. (2003) while the loneliness item was extrapolated and turned into a separate state measure. Participants were asked to rate intensity of their feelings on 7-item Likert scale (from 1 - not at all to 7 - very). The following items were used for each subscale: *Loneliness*: 'How lonely do you feel just now?', 'How isolated do you feel just now?', 'Do you lack companionship?'; *Negative Affect*: 'How down do you feel just now?', 'How guilty do you feel just now?', 'How anxious do you feel just now?'; *Positive affect*: 'How happy do you feel just now?', 'How cheerful do you feel just now?', 'How satisfied do you feel just now?'.

The Revised UCLA Loneliness Scale (R-UCLA; Russell, 1996), this 20-item scale was used to estimate one's subjective feelings of loneliness and social isolation. The measure is highly reliable, (internal consistency between .89 and .94) and test-retest reliability over a 1-year period $r = .73$. The R-UCLA has a good convergent validity as demonstrated by significant correlations with other measures of loneliness (Russell, 1996). One can score between 20 and 80 on this scale, with a higher score indicating higher level of loneliness.

The Revised Launay-Slade Hallucination Scale (LSHS-R; Launay & Slade, 1981), modified by R. Bentall and Slade (1985), this scale was used to measure predisposition to hallucinations

in general population. It consists of 12 items scored on a five-point scale which encompasses clinical and subclinical hallucinatory experience. The LSHS-R is a reliable and valid instrument (Aleman, Bocker, & de Haan, 1999). One can score between 0 - 48 with the higher score representing higher hallucination proneness.

The Creative Experiences Questionnaire (CEQ; Merckelbach, Horselenberg, & Muris, 2001) is a measure of fantasy proneness. It comprises 25 dichotomous items related to fantasy proneness. Sample items are: “In general, I spend at least half of the day fantasizing or daydreaming”; “My fantasies are so vivid that they are like a good movie”; and “I tend to confuse my fantasies with memories of real events”. CEQ’s internal and test-retest reliabilities are good and the scale correlates strongly with concurrent measures of fantasy proneness (Merckelbach et al., 2001).

Qualitative interviews

Brief qualitative interviews were carried out with a proportion of the participants in order to further examine the effectiveness of mood induction procedures. The interview consisted of open questions such as ‘How did you feel when you were asked to recall a time in your life when you felt lonely?’, ‘How intense would you say these feelings were?’ or ‘How did watching the film make you feel?’.

2.8 Statistical Analyses

Data was analysed using R version 3.2.3. For the emotional Stroop Task a two-way mixed models ANOVA was conducted to compare the reaction times between groups in relation to type of words. For the Jumbled Speech Task and Ambiguous Images task, logistic regression was conducted and odds ratios calculated.

3. Results

3.1. Participant characteristics

Participants were 62 healthy older people aged 65 and over (32 women; mean age = 73.7 years, SD = 6.46, age range 65-92). Descriptive statistics for all variables are presented in Table 2. Group differences in levels of anxiety and depression and other baseline measures were not significant (all t-values < 1.66 all p-values > 0.10); participants also did not differ significantly across demographic variables (all t-values < 0.13 and $\chi^2 < 0.06$, all p-values > 0.80). The scores on the Jumbled Speech Task, Launay–Slade Hallucination Scale and Creative Experiences Questionnaire displayed a half-normal distribution, which is typical for tasks assessing psychotic experiences (van Os et al., 2009) while scores on other measures were distributed normally.

Power Calculation

The data from our two experimental tasks was inherently binary and thus standard analysis techniques assuming a normally distributed outcome variable may be misleading. The original power calculation was, however, based on a normal distribution. In order to assess the power of this analysis in the current setting we simulated data sets with a known effect and obtained a p-value from the logistic regression analysis. For logistic regression, the N required to detect an effect of approximately -.3 on the log odds scale with 80% is 110. The sample size of 62 that we achieved had 54% power to detect this magnitude of effect. This impacts on precision of the results, an adequately powered study would produce a more precise effect.

Table 2. Descriptive statistics for all variables.

	Lonely N=31	Neutral N=31
<u>Demographic variables</u>		
Age - Mean (SD)	73.77 (6.95)	73.61 (6.16)
Education - Mean number of years (SD)	15.92 (4.13)	15.77 (4.36)
Sex – Number of Females (%)	15 (48%)	17 (55%)
Relationship status - In relationship (%)	14 (45%)	13 (42%)
Living on their own (%)	17 (55%)	16 (52%)
<u>Baseline measures</u>		
Mean <i>HADS</i> Anxiety score (SD)	4.81 (2.90)	4.00 (2.68)
Mean <i>HADS</i> Depression score (SD)	3.55 (2.62)	3.29 (2.30)
Mean <i>LSHS-R</i> score (SD)	13.35 (8.88)	10.29 (5.17)
Median/range	13.0 / 1 - 35	9.0 / 3 - 21
Mean <i>CEQ</i> score (SD)	6.26 (3.86)	5.16 (3.28)
Median/range	6.0 / 1 - 13	5.0 / 1 - 13
Mean <i>R-UCLA</i> score (SD)	41.48 (10.86)	39.84 (8.77)
<u>Emotional Stroop Task</u>		
Mean lonely words response time - ms (SE)	1087.60 (22.64)	1159.98 (85.24)
Mean negative words response time - ms (SE)	1045.43 (13.31)	1071.69 (18.82)
Mean neutral words response time - ms (SE)	1044.74 (14.40)	1106.26 (25.84)
Mean positive words response time - ms (SE)	1032.74 (15.14)	1090.42 (32.48)
Mean response time – ms (SE)	1052.63 (8.40)	1107.09 (24.15)
<u>Experimental measures</u>		
Mean no. of words heard in JST (SD)	3.61 (4.67)	2.65 (3.36)
Median/range	2.0 / 0 - 17	2.0 / 0 - 12
Mean no. of faces/figures perceived in AIT (SD)	7.26 (3.73)	7.26 (3.53)
<u>Ancillary measures</u>		
Mean State Loneliness Measure score (SD)	4.81 (2.09)	4.39 (2.01)
Mean State Negative Affect Measure score (SD)	5.29 (2.62)	4.19 (1.49)
Mean State Positive Affect Measure score (SD)	14.87 (3.35)	15.42 (3.49)

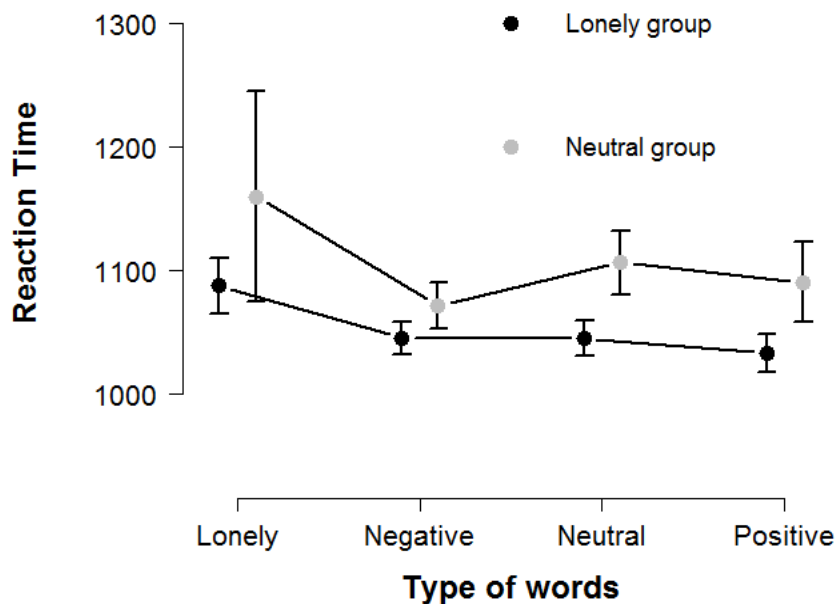
Note: *HADS* – Hospital Anxiety and Depression Scale (range on each scale 0 – 21), *LSHS-R* - The Revised Launay-Slade Hallucination Scale (range: 0 – 48), *R-UCLA* - The Revised UCLA Loneliness Scale (range 20 – 80), *CEQ* - Creative Experiences Questionnaire (range: 0- 25), *JST* – Jumbled Speech Task (range 0 – 24), *AIT* - Ambiguous Images Task (range: 0 – 20). For all of the scales the higher the score, the higher level of a measured item/feature.

3.2 Effectiveness of mood induction procedure

Emotional Stroop Task

Analysis of variance was conducted to compare mean reaction times between groups. One participant was identified as an outlier and excluded from analyses due to an accuracy of response below 20%. Only correct responses were analysed and the accuracy of the responses of the remaining participants was at least 95%. Contrary to expectations, participants in the lonely condition tended to respond more quickly across all 4 word categories than those in the neutral condition. Analysis of variance revealed no significant differences in reaction times between groups in terms of words type ($F(3, 177) = 0.18$, $p\text{-value} = 0.77$; corrected for violation of sphericity using the Greenhouse-Geisser correction). As shown in Figure 1, overall reaction times of participants in the neutral group were longer than for those in the lonely group, although this difference was not significant ($F(1, 59) = 1.03$, $p\text{-value} = 0.31$).

Figure1. Average emotional Stroop Task response times across groups (error bars represent standard errors).



State measures

Analysis of variance was performed to test whether participants differed in their scores on the state measures and revealed no interaction between subsets of the state measures (lonely, negative, positive) and condition participants were in, suggesting that condition did not affect one domain specifically ($F(2, 120) = 1.34$, $p\text{-value} = 0.25$; corrected for violation of sphericity using the Greenhouse-Geisser correction). Table 2 shows descriptive values for these measures.

3.2 JST performance

Overall 61% of participants reported hearing words in the Jumbled Speech Task, including 65% of the lonely induction group and 58% of the neutral induction group. Table 2 presents mean and median number of words heard for each group. To ensure sufficient power and to take account of the skewed nature of the data, a logistic regression analysis was conducted to predict the likelihood of hearing words across the 24 sound clips of JST, using the experimental condition as a predictor. Additional exploratory analyses were conducted to assess the potential role of further covariates in predicting the frequency of anomalous hearing. The distinction between confirmatory and exploratory analyses is increasingly being highlighted for the analysis of behavioural experiments (see: Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012). Greater weight should be placed on the outcome of confirmatory analyses, but exploring data is crucial for opening up potential future avenues of exploration.

A test of the full model against a constant-only model was statistically significant, indicating that adding the experimental condition as a predictor significantly improved model fit ($\chi^2(1) = 5.35$, $p < .02$). As shown in Table 3, participants in the neutral condition were less likely to hear words in the JST than those in the experimental condition with OR value of 0.70 (95% CI 0.51 – 0.94, $p < 0.05$).

An exploratory stepwise logistic regression analysis was also conducted to ascertain whether other factors might contribute to predicting the frequency of word hearing. Based on previous research we were interested to see whether scores on the hallucination scale and fantasy proneness could improve the model fit, as higher scores on these measures were previously reported as predictors of auditory hallucinations (Merckelbach & van de Ven, 2001). In line with other findings that suggested loneliness mediates the development of psychosis (van der Werf et al., 2010), we were also interested to see whether scores on the trait loneliness measure

(UCLA) and the state loneliness measure could improve the model fit. Finally, in line with previous findings that the negative affect has an effect on reality discrimination (Smailes et al., 2014), we also examined whether adding the score obtained on the negative affect scale could improve the model fit.

Out of these measures, only the addition of the State Loneliness improved the model fit significantly ($\chi^2(1) = 4.52$, $p < 0.03$). As shown in Table 3, higher scores on the state loneliness measure were associated with an increase in the likelihood of hearing words (OR=1.17, 95% CI 1.01-1.35, $p = 0.03$). Of note is that it is not an interaction model, and so the higher score on state loneliness was a predictor regardless of the experimental condition. The other predictors were not significant (all $\chi^2 > -2.91$, all p -values > 0.20).

Table 3. Stepwise logistic regression

	AIC	B (SE)	95% CI for odds ratio		
			Lower	Odds ratio	Upper
Step 1					
Constant	471.66	-1.73*** (0.27)			
Condition (Neutral)		-0.36* (0.16)	0.51	0.70	0.94
Step 2	465.79				
Constant		-1.76*** (0.10)			
Condition (Neutral)		-0.33* (0.16)	0.53	0.72	0.97
State Loneliness		0.16* (0.07)	1.01	1.17	1.35

* $p < 0.05$, *** $p < 0.001$

3.3 Ambiguous Image task

A logistic regression analysis was conducted to predict likelihood of detecting faces and human like agents in the ambiguous drawings for participants using the experimental condition as a predictor. A test of the full model against a constant only model was not statistically significant, indicating that adding the experimental condition as a predictor did not improve model fit ($\chi^2(1) = -1.42 \times 10^{-13}$, $p > 0.99$). Participants in both groups were equally likely to detect faces/human agents on this task. Table 4 presents correlations between variables, although we urge caution in interpretation due to limited power and skewed data.

Table 4. Correlations between key study variables, n = 62.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Anxiety												
2. Depression	0.45											
3. JST	0.01	0.05										
4. AIT	0.03	0.01	0.23									
5. State loneliness	0.31	0.25	0.12	0.05								
6. State negative affect	0.38	0.29	0.05	0.07	0.75							
7. State positive affect	-0.16	-0.35	-0.06	-0.05	-0.4	-0.51						
8. LSHS	0.49	0.21	-0.04	0.13	0.25	0.24	-0.04					
9. UCLA	0.44	0.46	-0.06	-0.08	0.31	0.39	-0.46	0.3				
10. CEQ	0.09	0.09	0.05	-0.03	0.05	-0.01	0.07	0.53	0			
11. Age	0.01	0.03	-0.38	-0.16	0.11	0.1	0.01	0.01	-0.01	-0.04		
12. Education	0.08	0.09	0.09	0.16	-0.1	-0.03	-0.05	-0.01	0.02	-0.08	-0.16	

Note: JST - Jumbled Speech Task, AIT - Ambiguous Images Task, LSHS - The Revised Launay–Slade Hallucination Scale, R-UCLA - The Revised UCLA Loneliness Scale, CEQ - Creative Experiences Questionnaire. For all of the measures the higher the score the higher the symptom/trait measured.

3.4. *Qualitative interviews*

It was observed during debriefs that some participants struggled to think of a time when they felt lonely and occasionally reported experiencing feelings other than expected from the mood induction tasks. Subsequently, a decision was made to carry out brief qualitative interviews with remaining participants in order to verify what kind of feelings they actually did experience during performance of the induction tasks. Nine participants from the lonely group and six participants from the neutral group were interviewed. In the lonely group, 3 out of the 9 interviewed persons reported that thinking of a time when they felt lonely and watching a film depicting a life of a lonely older person did indeed make them feel more lonely. The other 6 people, however, reported empathising with the man in the film but not feeling any more lonely themselves. In fact, two participants expressed feelings of frustration, wishing the character from the film ‘got out and did more things’. Two participants expressed feelings of relief that the film did not relate to their circumstances, others expressed relief because they used to feel lonely but managed to overcome these feelings. Participants in the neutral condition reported recalling the journey to the department and watching a film about the weather as not evoking any particular emotions, most considered the film interesting and the journey as neutral, nobody reported feeling any more lonely or positive/negative after completing these tasks.

4. Discussion

This study used a randomised controlled design to test the hypotheses that experimentally induced loneliness would lead older people to an increased proneness to experiencing subclinical auditory hallucinations and perceiving human-like features in ambiguous visual stimuli, thus providing a direct test of the theory that increased loneliness leads to a bias towards detecting human agency and social information (Epley et al., 2008; Hoffman, 2007). Consistent with this, participants who received the loneliness induction were more likely to hear words when presented with ambiguous *auditory* stimuli than those who received the emotionally neutral procedure. These findings are congruent with Hoffman’s social deafferentation (SDA) hypothesis, which postulates that loneliness might initiate social cognition programs to produce false social meaning in the form of emotionally compelling hallucinations/delusions representing other persons or agents (Hoffman, 2007). This theory may help to explain a number of linked phenomena, including post-bereavement hallucinations

of loved ones, imaginary companions, as well as the finding that loneliness mediates the development of psychosis (van der Werf et al., 2010).

On the other hand, those who received the loneliness induction were no more likely to detect human faces or figures in ambiguous visual stimuli. Although this is inconsistent with Hoffman's hypothesis, one reason for this might be that the visual task, a secondary outcome of the current study, was completed by participants after they completed the auditory task, which was deliberately given primacy in our design. From an unpublished study of Smailes (2014) we know that the effect of the mood induction lasts for approximately five minutes, whereas the emotional Stroop and Jumbled Speech Task generally took our older participants longer than 5 minutes to complete.

A high proportion of all participants (61%) heard at least one word in the Jumbled Speech Task. This observation is in line with previous reports on auditory hallucinations in non-clinical population. For example, in the White Christmas experiment reported by Merckelbach and van de Ven (2001), 32% of healthy participants reported hearing the White Christmas record in white noise despite the record never being played. The researchers reported that participants who heard the White Christmas record had significantly higher scores on the Launay-Slade Hallucination Scale (LSHS) and on the fantasy proneness questionnaire (CEQ), with CEQ being the strongest predictor for auditory hallucinations. Contrary to their findings, however, we did not observe associations between hearing words and higher scores on these measures. This discrepancy could perhaps be explained by the different populations we examined, as Marckelbach & van de Ven's study was conducted on undergraduate students.

Although not significant, mean scores on the hallucination scale (LSHS-R) in our sample were moderately higher in magnitude in the loneliness induction group relative to the neutral group (Cohen's d 0.43, 95% CI -0.07, 0.92, $p > .05$) which was unexpected given the randomised nature of our study. To minimise the risk of participants becoming aware of the study hypothesis, they were asked to fill in this and other measures after completion of the experimental tasks. Although these were completed after a suitable delay, we cannot rule out the possibility that the loneliness induction could have affected participants' responses on this measure. If replicated by others, this might be suggestive of a longer-lasting effect of loneliness induction on the perception of subclinical psychotic symptoms.

The emotional Stroop task performance, where those in the lonely condition performed more quickly than those in the neutral group (although not significantly), was also contrary to our predictions and at odds with previous findings on emotional Stroop task interference effect. One way of interpreting this finding might be that the neutral condition had a more profound effect on participants than the lonely condition. This, however, is not very likely, given the nature of the induction tasks.

Another possible explanation for this observation might be related to the nature of mood induction and the ‘positivity effect’ that has been observed in older adults specifically. Holland and Kensinger (2010) in their literature review on mood and autobiographical memory reported that a ‘mood-congruent memory effect’ occurs when people are in a positive mood but is found less reliably when people are in a negative mood. They concluded that due to an unpleasant nature of negative mood states, individuals in such a mood state are motivated to change their mood into a more positive one. The ‘positivity effect’ is a term coined by Reed and Carstensen (2012) in response to accumulated evidence that older adults show preference for positive over negative information in attention and memory, relative to their younger counterparts (see: Charles, Mather, & Carstensen, 2003; Mather & Carstensen, 2003; Mikels, Larkin, Reuter-Lorenz, & Carstensen, 2005). Older people favor positive over negative stimuli across a range of experimental materials including emotional faces (Mather & Carstensen, 2003), emotionally-valenced images (Charles et al., 2003; Spaniol, Voss, & Grady, 2008), and word lists (Piguet, Connally, Krendl, Huot, & Corkin, 2008). This mechanism is explained by a change in life-goals based on time horizons. When time horizons are constrained, which is more relevant to older people, present-oriented goals related to emotional satisfaction and meaning are prioritized over goals associated with long-term rewards. It is possible that participants in the lonely group engaged in automatic counterbalancing to the negative aspect of connecting to the lonely time in their life, which influenced the emotional Stroop results.

The scores on our explicit state loneliness and negative affect measures were higher in the loneliness group, although not significantly. This could be congruent with findings from our qualitative interviews, which indicate that not every participant in the lonely induction group experienced feeling of loneliness as a result of induction. Reports of feelings of frustration or relief suggest that there was a variability in emotions actually induced in the experimental condition, and this might have been reflected on the state measures.

4.1 Limitations

One limitation of the present study was that the researcher was not blinded to experimental conditions. This was related to frequent unblinding of the investigator due to technical difficulties that some participants encountered related to hearing aids and volume adjustment and other computer-use related issues. Another limitation relates to the ecological validity of the loneliness induction that was used. Eysenck (2013) argues that mood inductions based on asking participants to recall a life event in which they experienced emotion of interest, leads to induction of so called ‘incidental emotions’ as oppose to ‘integral emotions’. While integral emotions are of direct relevance to the situation and the task at hand, incidental emotions are carried over from a previous situation and so are essentially irrelevant to the current task, which is typical of most experimental studies (Eysenck, 2013). However, the majority of our decision-making in real life is influenced by integral emotions, which naturally differentiates the real life situation from one that is experimentally induced. It is also possible that the form of mood induction we used, even though strengthened by the video stimuli, is not the most effective in older adults and that there might be more effective ways of inducing mood in this population. Given the ethical problems raised by trying to increase the intensity of loneliness inductions, an alternative approach may be to try to enrich the sample, for example by randomising only those who demonstrate a sufficient degree of responsiveness to the experimental mood induction. Finally, future studies examining the effects of loneliness in older people may benefit from considering strategies to counterbalance the positivity effect that has been observed with this group. Such strategies may involve increasing the demands placed on cognitive resources that might otherwise be deployed automatically to counter negative affect. Another limitation to this study is related to our exclusion criteria of not including participants who experience severe distress, therefore potentially reducing a pool of participants prone to experiencing psychotic symptoms. This decision was taken in order to ensure safety of our participants, however, it also has significant implications for our study. For an analogue study it would be necessary to ascertain that the distribution of participants in the sample represents the studied population well which, in case of a phenomena that is observed on a continuum, means that those who present on either side of the spectrum should be represented. The exclusion of distressed participants means that our study did not meet the assumptions for the analogous population. It is therefore important to highlight that the results we found are indicative but not conclusive and the future studies would benefit from including

a more comprehensive sample of participants. This could perhaps be done by changing the paradigm so that it was ethical to pursue the research question with the full range of participants. Testing the effectiveness of interventions against loneliness on reduction of proneness to hallucinatory experiences might be an approach that would allow for this.

5. Conclusions

Overall, the findings of the current study suggest that asking older adults to both reflect on a time when they felt lonely and observe an older person who is experiencing loneliness, causes them to be more likely to detect words in ambiguous auditory stimuli. This is consistent with the hypothesis that loneliness activates a cognitive bias to perceive human-like features, which may be explained by Hoffman's social deafferentation hypothesis, which proposes that psychotic symptoms such as auditory verbal hallucinations emerge in direct response to social isolation, as well as Epley's anthropomorphism hypothesis, which suggests that human beings are driven by the need for social connection and control to detect human agency in non-human stimuli. Future studies with a much shorter delay between mood induction and ambiguous visual imagery tasks will be required before we can confidently conclude that this effect is confined to auditory stimuli. Although we struggled to demonstrate that our loneliness procedure did increase loneliness, a more plausible explanation for our unusual findings is that we encountered the 'positivity effect' that has been previously observed in emotional Stroop tasks with older adults. Indeed, one may speculate that an increased tendency to detect human-like stimuli might be another manifestation of this phenomenon, in so far as it may be yet another strategy that human beings deploy automatically to help them cope with adverse experiences, in this case loneliness.

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Appendix A.1 - Clinical Psychology Review: author guidelines

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Reference style

References should be arranged first alphabetically and then further sorted chronologically if necessary.

More than one reference from the same author(s) in the same year must be identified by the letters "a", "b", "c", etc., placed after the year of publication. **References should be formatted with a hanging indent (i.e., the first line of each reference is flush left while the subsequent lines are indented).**

Examples: Reference to a journal publication: Van der Geer, J., Hanraads, J. A. J., & Lupton R. A. (2000). The art of writing a scientific article. *Journal of Scientific Communications*, 163, 51-59.

Reference to a book: Strunk, W., Jr., & White, E. B. (1979). *The elements of style*. (3rd ed.). New York: Macmillan, (Chapter 4).

Reference to a chapter in an edited book: Mettam, G. R., & Adams, L. B. (1994). How to prepare an electronic version of your article. In B.S. Jones, & R. Z. Smith (Eds.), *Introduction to the electronic age* (pp. 281-304). New York: E-Publishing Inc.

Supplementary material

Supplementary material can support and enhance your scientific research. Supplementary files offer the author additional possibilities to publish supporting applications, high-resolution images, background datasets, sound clips and more. Please note that such items are published online exactly as they are submitted; there is no typesetting involved (supplementary data supplied as an Excel file or as a PowerPoint slide will appear as such online). Please submit the material together with the article and supply a concise and descriptive caption for each file. If you wish to make any changes to supplementary data during any stage of the process, then please make sure to provide an updated file, and do not annotate any corrections on a previous version. Please also make sure to switch off the 'Track Changes' option in any Microsoft Office files as these will appear in the published supplementary file(s). For more detailed instructions please visit our artwork instruction pages at <https://www.elsevier.com/artworkinstructions>.

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The following list will be useful during the final checking of an article prior to sending it to the journal

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Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:

- E-mail address
- Full postal address

All necessary files have been uploaded, and contain:

- Keywords
- All figure captions
- All tables (including title, description, footnotes)

Further considerations

- Manuscript has been 'spell-checked' and 'grammar-checked'
- References are in the correct format for this journal
- All references mentioned in the Reference list are cited in the text, and vice versa
- Permission has been obtained for use of copyrighted material from other sources (including the Internet)
- Printed version of figures (if applicable) in color or black-and-white
- Indicate clearly whether or not color or black-and-white in print is required.

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Appendix B.1 - Study Quality Assessment Tool

This is an adapted version of a tool for assessing the methodological quality of observational studies that has been successfully employed in prior research undertaken by the Agency for Healthcare Research and Quality (AHRQ). Each study is assessed on a range of methodological quality criteria that are rated as being met, not met, partially met, or being unclear. This tool has been followed closely from Taylor et al., (2015).

In the current study scale-based or aggregated study quality rating was not performed, based on the guidance of experts in the field of meta-analysis. Quality assessments were presented descriptively to guide the interpretation of findings, rather than used as a means to weight or adjust aggregated effect sizes. The tool we applied is presented below.

General instructions: Grade each criterion as 'Yes', 'No', 'Partially', or 'Can't tell'. Factors to consider when making an assessment are listed under each criterion. Where appropriate (particularly when assigning a 'No', 'Partially', or 'Can't tell' score), please provide a brief rationale for your decision (in parentheses) in the evidence table.

1. Unbiased selection of the cohort?

Factors that help reduce selection bias:

- Inclusion/exclusion criteria:
- Recruitment strategy
 - Clearly described
 - Criteria for inclusion in psychosis/delusions and comparison groups clearly outlined.
 - Relatively free from bias (selection bias might be introduced, for example, by recruitment via advertisement).

2. Selection minimizes baseline differences in prognostic factors?

Factors to consider:

- Was selection of the comparison group appropriate?
- Is the comparison group matched with the clinical group on key demographics (that is age and gender)?

3. Sample size calculated?

Factors to consider:

- Did the authors report conducting a power analysis or describe some other basis for determining the adequacy of study group sizes for the primary outcome(s) of interest to us?
- Where a power calculation is presented, do the final numbers obtained match up to this (for example, within 10% of required numbers)?

4. Adequate description of the cohort?

Consider whether the cohort is well-characterized in terms of baseline:

- Age
- Sex
- Ethnicity
- Diagnosis/clinical status

5. Validated method for ascertaining psychotic disorder or delusions?

Factors to consider:

- Was the method used to ascertain exposure clearly described (details should be sufficient to permit replication in new studies)?
- Was a valid and reliable measure used to ascertain exposure (subjective measures based on self-report tend to have lower reliability and validity than objective measures such as clinical interview)? Likewise, relying on medical notes is likely to introduce bias due to variation in how assessment is undertaken.

6. Validated method for ascertaining ‘jumping to conclusions’?

Factors to consider:

- The beads task or a conceptually equivalent variant should be used
- Were these measures implemented consistently across all study participants?
- Were several trials and/or a practice run included in the procedure?

7. Outcome assessment blind to exposure?

Factors to consider:

- Were the study investigators who assessed outcomes blind to whether participants had a psychotic disorder or delusions (this criterion will not apply in the case of Internet-based or automated designs where a researcher is not present)?

8. Adequate handling of missing data?

Factors to consider:

- Are the details of missing data clearly reported, including how missing data was handled in the analyses? If not, is there any reason to believe missing data was present (for example, lower N in analysis than initially reported in the participants section).
- Did missing data from any group exceed 20%?
- If missing data was present and substantial, were steps taken to minimize bias (for example, sensitivity analysis or imputation).

Appendix C.1 - GRADE assessment of all outcomes

Method

Quality assessments were conducted independently by two reviewers - one reviewer (BM) assessed all of the studies while the second reviewer (EV) assessed a proportion of studies, with any disagreements resolved through discussion with the third author (PH).

For assessment of outcome quality, we downgraded by 1 point if two of the parameters in our quality assessment had $\geq 50\%$ studies with at least one 'no' or 'unclear' rating, and 2 points if three parameters had $\geq 50\%$ studies with ratings of 'no or unclear'.

We downgraded by 1 point for inconsistency if the I^2 statistic was $\geq 40\%$ in the context of an unclear direction of effect or $\geq 75\%$ in the context of a clear direction of effect. We downgraded by 2 points if the I^2 statistic was $\geq 75\%$ in the context of an unclear direction of effect. We downgraded an outcome for imprecision if "a recommendation or clinical course of action would differ if the upper versus the lower boundary of the CI represented the truth" and / or the number of events and sample size meant the optimal information size was not reached.

We downgraded for publication bias when funnel-plot suggested asymmetry which would be confirmed in the Egger's regression test and the Rank correlation test, and this was not better explained by selective reporting bias or some other factor.

Outcome

Based on the following criteria we downgraded the overall outcome by 1 point due to the high heterogeneity as indicated by the I^2 statistic.

Appendix D.1 – Study Protocol

Loneliness in psychosis: a meta-analytical review

Beata Michalska da Rocha, Stephen Rhodes, Paul Hutton, Eleni Vasilopoulou

Citation

Beata Michalska da Rocha, Stephen Rhodes, Paul Hutton, Eleni Vasilopoulou. Loneliness in psychosis: a meta-analytical review. PROSPERO 2016:CRD42016015371 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016015371

Review question(s)

Is there an association between loneliness and psychotic symptoms in people with a psychotic disorder.

Searches

Electronic databases (PsycINFO, MEDLINE, EMBASE and Web of Science) will be searched using the following terms: (psychos* or schiz* or halluc* or paran* or delus* or psychotic) AND (lonel*) AND/OR (at risk or ultra high risk or clinical high risk or UHR or CHR or prodrom* or psychosis risk or psychosis transition or psychosis onset). Hand searches of references in eligible articles and key review articles will also be undertaken. Conference abstracts and theses identified through the searches will also be followed-up. All initial searches and screening will be undertaken by one reviewer under supervision of the second author.

Types of study to be included

Cross-sectional, correlational studies, cohort studies, case-control studies, prospective studies.

Condition or domain being studied

Subjectively measured loneliness (as measured by specified loneliness measures). For the purposes of the review we define loneliness as dissatisfaction with the desired and actual number or quality of social relationships (Peplau & Perlman, 1982).

We are not going to examine social isolation or size of social network unless it clearly reflects our measure of loneliness. While social isolation can be an objectively quantifiable variable, loneliness is a subjective emotional state of the individual, which may be present in

non-isolated individuals with large social networks, and absent in isolated individuals with minimal social networks, and thus involves necessarily subjective measurement.

Participants/ population

- Clinical population (patients with established psychotic disorder).

Intervention(s), exposure(s)

Not applicable

Comparator(s)/ control

We will include studies where people with diagnosis of psychotic disorder are compared to any other non-psychotic clinical group with respect to ratings of loneliness, as well as studies where they are compared to healthy individuals, and studies where they are compared to people at-risk of developing psychosis. We will also include studies reporting a cross-sectional correlation between psychotic symptoms and loneliness within a group of individuals with psychosis.

Outcome(s)

Primary outcomes

Loneliness mean score on a validated loneliness measure.

In case if multiple measures of loneliness are reported, we will extract and analyse loneliness data according to the following hierarchy: UCLA > de Jong-Gierveld Loneliness Scale > Social and Emotional Loneliness Scale for Adults (SELSA) > any continuous measure of loneliness reported by the authors as long as it measures loneliness according to the following definition: loneliness understood as dissatisfaction with the desired and actual number or quality of social relationship (Peplau & Perlman, 1982).

In case if multiple measures of psychotic symptoms are reported, we will extract and analyse psychotic symptoms data according to the following hierarchy:

In healthy individuals: CAPE > CAPS > any continuous measure of psychotic symptoms reported by the authors.

In at-risk individuals: CAARMS > SIPS/SOPS > any continuous measure of psychotic symptoms reported by the authors.

In people with established psychosis: PANSS > BPRS > any continuous measure of psychotic symptoms reported by the authors.

If more than one measure of specific symptoms is reported, we will take an average measure of effect sizes.

Secondary outcomes

Not applicable.

Data extraction, (selection and coding)

Data will be extracted by two independent reviewer with inconsistencies resolved through discussion with a third author. Extracted data will include sample characteristics (age, gender, recruitment source, ethnicity and socio-economic status), study characteristics (study design, type of publication, year of publication, location), measures (type of instruments used to measure loneliness, assessment of psychotic disorder) and statistics (inferential and descriptive data relating to loneliness).

Risk of bias (quality) assessment

Two raters will independently undertake the ratings of risk of bias and methodological quality, with the third author acting as arbitrator. Methodological quality assessment will be reported descriptively. A methodological quality assessment tool for observational research, adapted from one used by the Agency for Healthcare Research and Quality (AHRQ; Williams, Plassman, Burke, Holsinger, & Benjamin, 2010) will be used. In addition, the GRADE approach to quality assessment will be used to rate methodological quality at an outcome level.

In addition, we will test if specific methodological features of the studies moderate the effect size obtained through meta-analyses. In particular we will test the following moderators:

- a) The blinding of researchers to participants' clinical status or group
 - b) The matching of participants between groups on demographics
 - c) How the loneliness was reported/measured – quality of psychometric instruments applied
- Publication bias will be tested for using funnel plots and applying the Trim and Fill Method. Heterogeneity will be assessed using the Q-statistics and I-squared statistic.

Strategy for data synthesis

Meta-analyses of data will be conducted for each of the groups independently. For each of the samples, we will compute an odds ratio (OR) of the relationship between psychosis and loneliness, converting data and summary statistics according to guidelines in Borenstein et al., (2009). Computing OR allows us to combine continuous and binary data from a range of different measures reported in a range of different study designs. These ORs will then be entered into a random-effects meta-analysis, conducted separately for each of the population groups (healthy, at-risk and established psychosis). The resulting effect sizes will produce

clear and comparable estimates of the magnitude of any relationship, which we will interpret according to recommendations by Chen et al (2010), who estimate that ORs of 1.68, 3.47, and 6.71 are equivalent to Cohen's d of 0.2 (small), 0.5 (medium), and 0.8 (large), respectively.

Analysis of subgroups or subsets

A scoping review established that some relevant studies did not use a valid and well-established measure of loneliness. We adopted a liberal approach of including these studies. We will run a sensitivity analyses in order to compare the studies that used a valid and established measure of loneliness with those that did not.

Dissemination plans

The completed review will be submitted for publication to a peer-reviewed journal.

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Anticipated or actual start date

04 February 2016

Anticipated completion date

20 April 2016

Funding sources/sponsors

Not applicable.

Conflicts of interest

None known

Language

English

Country

Scotland

Date of registration in PROSPERO

05 February 2016

Date of publication of this revision

16 March 2016

Appendix E.1 - A list of excluded studies

The following table presents studies excluded after inspection of the full-text report, or via correspondence with authors. Studies excluded on basis of title or abstract alone are not detailed as these are too numerous.

Study	Reason for exclusion
Andersson G., Denhov A., Bulow P., Topor A., 2015	Qualitative study
Barut, Jennifer K., Dietrich, Mary S Zanoni, Paul A, Ridner, Sheila H., 2015	Qualitative study
Bebbington P, Wilkins S, Sham P, et al. 1996	Loneliness not measured
Beebe L.H., 2010	Qualitative study
Behrendt R.P., 2006	Not empirical
Bengtsson-Tops A, Hansson L., 2001	Loneliness not measured
Birnbaum M.L., 2010	Qualitative study
Brown, C 1996	Not specific to psychosis
Corrigan, P. W., & Phelan, S. M., 2004	Loneliness not measured
Cresswell CM, Kuipers L, Power MJ, 1992	Loneliness not measured
Davidson, L; Stayner, D., 1997	Qualitative study
De Niro, Dorothy Ann Nejedlo, 1993	Qualitative study
De Niro D.A., 1995	Qualitative study
de Pater, Margreet, 2012	Qualitative study
Doman, L. C. H.; Roux, A le., 2010	Not empirical
Druz, VF; Budza, VG; Oleinikova, IN; Medvedev, VA., 1998	Not in English
Druz, VF; Oleinikova, IN., 2000	Not in English
Elisha D., Castle D., Hocking B., 2006	Not specific to psychosis
Erdner A., Nystrom M., Severinsson E., Lutzen K., 2002	Qualitative study
Evert, H; Harvey, C; Trauer, T; Herrman, H., 2003	Loneliness not measured
Freeman, D., Gittins, M., Pugh, K., Antley, A., Slater, M., Dunn, G., 2008	Non-clinical sample
Gerstein, 1987	Psychotic symptoms not measured, control group limited to lonely people
Graham C, Arthur A and Howard R (2002)	Loneliness not measured
Granerud, A.; Severinsson, E., 2006	Qualitative study
Gruzelier J.H., 1996	Loneliness not measured
Hamilton NG, Ponzoha CA, Cutler DL, Weigel RM., 1989	Loneliness not measured
Harvey C.A. Brophy L., 2011	Not empirical
Honkonen, T; Saarinen, S; Salokangas, RKR., 1999	Loneliness not measured
Jablensky A, Mcgrath J, Herrman H, et al. (1999)	Loneliness not measured
Kudo J., Mori H., Gomibuchi T., 2002	Qualitative study
Lamster F.G., Nittel C., Lincoln T., Kircher T. et al., 2015	Non-clinical sample
Lim, M., Gleeson, J., 2014	Not empirical
Linz, Sheila J.; Sturm, Bonnie A., 2013	Not empirical
Lysaker PH, Davis LW (2004)	Loneliness not measured

Macdonald EM, Hayes RL, Baglioni AJ., 2000	Loneliness not measured
Maltsberger JT., Pompili M., Tatarelli R., 2006	Qualitative study
Morgan V.A., Jablensky A.V., Waterreus A., Bush R. et al., 2011	Abstract only, published elsewhere
Morgan, V.A., Waterreus, A., Jablensky, A., Mackinnon, A., et al, 2012	Loneliness not measured
Murphy, S; Murphy, J; Shevlin, M., 2015	Non-clinical sample (uses psychotic-like symptom screen but no diagnoses)
Nilsson B., Naden D., Lindstrom U.A., 2008	Qualitative study
Perese E, Marilee, W., 2005	Loneliness not measured
Riggio, HR., Kwong, WY., 2011	Non-clinical sample
Riggio, HR., Kwong, WY., 2009	Non-clinical sample
Romney, D.M., 1995	Loneliness not measured
Salokangas RK., 1997	Loneliness not measured
Schwartz et al., 2009	No measure of psychotic symptoms, no healthy control group
Sorensen, Leif V Mors, Ole., 1992	Loneliness not measured
Sundermann, O Onwumere, J Bebbington, P Kuipers, E., 2013	Not empirical
Talarowska-Bogusz, Monika; Florkowski, Antoni; Zboralski, Krzysztof; Cieslak, Katarzyna; Galecki, Piotr., 2008	Loneliness not measured
Tharayil D., 2005 – unpublished thesis dissertaton	Qualitative study
Tharayil, 2007	No measure of psychotic symptoms, no control group
Westermann S., Lincoln T.M., 2010	Loneliness not measured
Van Der Werf M. Van Winkel R. Van Os J., 2010	Conference abstract, published elsewhere
Boyda et al., 2015	reuse of the same sample
McManus et al., 2009	reuse of the same sample
Shevlin et al., 2015	reuse of the same sample
Stain et al., 2012	reuse of the same sample
Switaj et al., 2014	reuse of the same sample
Wciorka et al., 2015	reuse of the same sample
Borge et al., 1999	Relevant correlation data not provided / no contact with author
Cohen et al., 1997	Relevant correlation data not provided / no contact with author
Pjescic et al., 2014	Relevant correlation data not provided / no contact with author
Tylova et al., 2013	Abstract only, relevant data not provided / no contact with author
Young et al., 2015	Baseline data not accessible / no answer from the author
Van der Werf et al., 2010	Relevant data not provided on request

Appendix F.1 - PRISMA checklist

Section/topic		Checklist item	Reported on page
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	35
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	36
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	37
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	39
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Appendix D.1
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Table 1 p.12-14
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	40

Section/topic		Checklist item	Reported on page
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	40
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Figure 1. p. 8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	9 and appendices B.1 and C.1
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	10
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	16

Appendix G.1 - references of studies included solely in the meta-analysis

- Giblin, S., Clare, L., Livingston, G., & Howard, R. (2004). Psychosocial correlates of late-onset psychosis: life experiences, cognitive schemas, and attitudes to ageing. *International journal of geriatric psychiatry*, 19(7), 611-623.
- Lindner, C., Dannlowski, U., Walhöfer, K., Rödiger, M., Maisch, B., Bauer, J., . . . Kersting, A. (2014). Social alienation in schizophrenia patients: association with insula responsiveness to facial expressions of disgust. *PloS one*, 9(1), e85014.
- Ludwig, Zerbe, Calkins, Neustadter, Kohler, Turetsky, . . . Leitman. (2013). Perceptual correlates of interpersonal attachment and feelings of loneliness in schizophrenia. *Schizophrenia Bulletin.*, *Conference: 14th International Congress on Schizophrenia Research, ICOSR 2013 Orlando, FL United States.*
- Stein, C. H., Aguirre, R., & Hunt, M. G. (2013). Social netw

Appendix A.2 – Journal of Psychology: authors guidelines

Manuscript Preparation

Format: Number all pages of the manuscript sequentially. Manuscripts should contain each of the following elements in sequence: 1) Title page 2) Abstract 3) Text 4) Acknowledgments 5) References 6) Tables 7) Figures 8) Figure Legends 9) Permissions. Start each element on a new page. Because the Journal of Clinical Psychology utilizes an anonymous peer-review process, authors' names and affiliations should appear **ONLY** on the title page of the manuscript. Please submit the title page as a separate document within the attachment to facilitate the anonymous peer review process.

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Abstract. Abstracts are required for research articles, review articles, commentaries, and notes from the field. A structured abstract is required and should be 150 words or less. The headings that are required are:

Objective(s): Succinctly state the reason, aims or hypotheses of the study.

Method (or Design): Describe the sample (including size, gender and average age), setting, and research design of the study.

Results: Succinctly report the results that pertain to the expressed objective(s).

Conclusions: State the important conclusions and implications of the findings.

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Article Types

Research Articles . Research articles may include quantitative or qualitative investigations, or single-case research. They should contain Introduction, Methods, Results, Discussion, and Conclusion sections conforming to standard scientific reporting style (where appropriate, Results and Discussion may be combined).

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subdivisions (e.g., introduction, methods, results) are not required, the text should flow smoothly, and be divided logically by topical headings.

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Appendix B.2 – Ethical approval



SCHOOL of HEALTH IN SOCIAL SCIENCE
CLINICAL PSYCHOLOGY

The University of Edinburgh
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Beata Michalska
Trainee Clinical Psychologist

02 March 2015

Dear Beata,

Application for Level 2 Approval

Re: In older people, does loneliness increase proneness to experience auditory hallucinations and tendency to detect human agency?

Thank you for submitting the above research project for review by the Section of Clinical Psychology Ethics Research Panel. I can confirm that the submission has been independently reviewed and was approved on the 18th December 2015.

Should there be any change to the research protocol it is important that you alert us to this as this may necessitate further review.

Yours sincerely,

Kirsty Gardner
Administrator
Clinical Psychology

Appendix C.2 – Participant Information Sheet



Participant Information Sheet

Title of Project: Understanding factors impacting on hearing and vision in older people.

Name of Lead researcher: Beata Michalska – Trainee Clinical Psychologist,

Supervisors: Dr Lindsey Murray – Clinical supervisor and Dr Paul Hutton – Academic Supervisor.

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

We are interested in factors affecting hearing and vision in older adults. We are going to ask you to listen to and to watch some things, and then we will ask you questions about what you saw and heard. This study will inform us on how the auditory and visual information is processed by older adults in some particular circumstances.

Who can take part in the study?

We are looking to recruit participants aged 65 and over. You can take part if:

- **If you are 65 and above**

Unfortunately, you won't be able to take part if you have:

- **Vision/ hearing impairment – it is ok if the impairment is corrected for** with glasses or hearing aid.
- **Severe mental health problems** - such as severe depression or psychotic problems. These will be measured with questionnaires and assessed during interview.

We will ask you about this in the interview and if there is any evidence of this unfortunately we won't be able to include you in the study.

What will happen during the study?

The study will consist of a single meeting. During the meeting you will undertake a series of simple tasks, some of which will take place on a computer. We will also ask you to complete a few questionnaires. The meeting will last approximately between 40-60 minutes.

In the end of the session we will ask you some questions regarding your feelings about some of the tasks you have completed. We will record your answers and transcribe them, and the recording of your voice will be deleted immediately after the transcription has been done. This will enable us to look for the emerging themes in participant's responses.

We may ask you to perform some tasks that will make you feel temporarily lonely or upset. These feelings might be comparable to feelings you might experience after watching a sad film.

Initially, I will not be able to tell you in detail what the study is about because it could affect your answers. After completing the tasks I will explain the study in detail and you will have a chance to ask questions.

Most of the meetings/interviews will take place at the Old Medical School at the University of Edinburgh (Teviot Place). Travelling expenses will be reimbursed if needed. If for any reason this location was not suitable for you, it can be rearranged to suit your needs. Ask the researcher for more details.

What do I have to do?

It is important that the interviews are arranged at the time of a day when you are feeling well. Most tasks are in the form of questionnaires or simple puzzles. If you are unable to write we will assist you in filling out the questionnaires. The interview will last for approximately 40-60 minutes but if you need a break or wanted to withdraw from the study you will be able to do it at any point.

What are the possible disadvantages and risks of taking part?

We do not anticipate any health risks from taking part in this study. Although, we may ask you to perform some tasks that will make you feel temporarily lonely or upset. These feelings might be comparable to feelings you might experience after watching a sad film.

If you do feel distressed, you will be able to discuss this with the researcher who will be able to talk things through with you and provide you with self-help information if required.

Will my taking part in this study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential. Your name will not appear in our materials, computers or on any future publications. However, if you disclose any information that you intend to hurt yourself or others then we may have to breach your confidentiality in order to prevent this happening.

What will happen to the results of the research study?

The results of the research will be presented in a thesis project and published in a peer-reviewed scientific journal. The results might also be presented during presentations at conferences. In all cases your name and personal details will not be identified.

Who is organising the research?

The study is being organised by Beata Michalska – a researcher and trainee clinical psychologist from the University of Edinburgh. Dr. Paul Hutton, Chancellor's Fellow & Clinical Psychologist at the University of Edinburgh, and Dr. Lindsey Murray, Clinical Psychologist in NHS Fife, are supervising the project.

Contact for Further Information

If you wish to ask anything further then please contact Beata Michalska on 07449318999 or via email (B.Michalska@sms.ed.ac.uk).

If you have a complaint or concern about the research please contact Dr Paul Hutton on 0131 650 3889.

Thank you for reading this information sheet. You will be given a copy to keep. If you have understood this information sheet and wish to take part, please complete the consent form on the next page. If you have any questions please feel free to ask the researcher.

Please bear in mind that you are free to withdraw from the study at any point. Your data may also be removed if you request this at any time.

Thank you for reading this information sheet.

Appendix D.2 – Consent Form



CONSENT FORM

Title of Project: Understanding factors which impact on hearing and vision in older adults.

Name of Researcher: Bea Michalska – a researcher at the University of Edinburgh
Supervisors: Dr Paul Hutton - Chancellor's Fellow & Clinical Psychologist at the University of Edinburgh and Dr Lindsey Murray – Clinical Psychologist.

Tick the box

1. I confirm that I have read and that I understand the information sheet for the above study.
I also have had the opportunity to ask questions and I have them answered satisfactorily.

☐

2. I understand that I am free to withdraw at any time without giving any reason,
and that my participation is voluntary.

☐

3. I agree for my voice to be recorded for the purpose of data analyses

☐

4. I agree to take part in the above study.

☐

Name of Participant

Date

Signature

Name of Person taking consent

Date

Signature